United States Court of Appeals

for the Second Circuit

APPENDIX

ONLY COPY AVAILABLE

B

NO. 74-2284 et al.

Nos. 74-2284, 74-2286, 74-2308, 74-2450, 74-2449

JOINT APPENDIX TO THE BRIEFS

VOLUME V

IN THE UNITED STATES COURT OF APPEALS
FOR THE SECOND CIRCUIT

THE SOCIETY OF THE PLASTICS INDUSTRY, INC.,

HOOKER CHEMICALS & PLASTICS CORP.,

UNION CARBIDE CORPORATION,

TENNECO CHEMICALS, INC.

and

AIR PRODUCTS AND CHEMICALS, INC.,

Petitioners,

v.

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION,
UNITED STATES DEPARTMENT OF LABOR;
PETER J. BRENNAN, SECRETARY, DEPARTMENT OF LABOR;
and JOHN H. STENDER, ASSISTANT SECRETARY
FOR OCCUPATIONAL SAFETY AND HEALTH,

Respondents.

On Petition For Review Of An Order Of
The Occupational Safety and Health Administration,
United States Department of Labor

UNITED STATES COURT OF APPEALS
FILED
DEC 10 1974
CLERK
SECOND CIRCUIT

Submitted by:
MARTIN I. SHELTON
Shea Gould Climenko & Kramer
330 Madison Avenue
New York, New York 10017

Attorney for The Society of
the Plastics Industry, Inc.

Prepared by:
ALLAN J. TOPOL
JONATHAN M. WEISGALL
Covington & Burling
888 Sixteenth Street, N.W.
Washington, D.C. 20006

Attorneys for Hooker Chemicals
& Plastics Corp., Tenneco
Chemicals, Inc., and Air
Products and Chemicals, Inc.

November 12, 1974

ONLY COPY AVAILABLE

PAGINATION AS IN ORIGINAL COPY

TABLE OF CONTENTS OF JOINT APPENDIX

VOLUME V

ONLY COPY AVAILABLE

Record Number (If Any)	Document	Appendix Page
100	Post-Hearing Submission of Uniroyal Correcting a Portion of its Hearing submission	1606
209	Testimony of C. R. Pelino, Director of Procurement, Stromberg-Carlson Corporation	1607
209	Portions of Cross-Examination of Mr. Pelino	1611
	Errata Sheet for Testimony Pages 1515 Through 1562	1614
39D	Report to the Surgeon General, "Evaluation of Environmental Carcinogens," Ad Hoc Committee on the Evaluation of Low Levels of Environmental Carcinogens, National Cancer Institute	1615
209	Portions of Cross-Examination of Mr. Bertram R. Cottine of Health Research Group	1626
209	Portions of Testimony of William M. Nichols of General Cable Corporation	1632
209	Portions of Cross-Examination of Mr. Nichols of General Cable Corp.	1636
	Errata Sheet for Testimony Pages 1562 Through 1584	1640
45	Written Subsmission of Norman V. Germany on Behalf of American Footware Industries Association at the Hearing	1642
48A	Written Submission of Todd Walker, President, Firestone Plastics Company, at the Hearing	1665

48B	Written Submission of F. F. Hoy, Firestone Plastics Company, at the Hearing	1694
48C	Written Statement of Position of Firestone Plastics Company Submitted at Hearing	1712
209	Portions of Testimony of Todd C. Walker of Firestone Plastics Company	1947
209	Portions of Testimony of Mr. Hoy of Firestone Plastics Company	1950
209	Portions of Testimony of Mr. Walker of Firestone Plastics Company	1955
209	Cross-Examination of Mr. Walker, Mr. Hoy and Others of Firestone Plastics Company . .	1957

(Continued in Volume VI.)

1386

100

UNIROYAL CHEMICAL
Division of UNIROYAL, Inc.
Elm Street
Naugatuck, Connecticut 06770
203-729-5241

July 11, 1974

Mr. Julius Jimeno
Hearing Management Officer
Occupational Safety and Health Administration
1726 M Street, N.W.
Room 200, U.S. Department of Labor
Washington, D.C. 20210

Re: Docket OSH-36
Public Hearing - Proposed Standard for Occupational Exposure to Vinyl Chloride - Submitted Written Testimony of Uniroyal, Inc. on July 9, 1974

Dear Mr. Jimeno:

Would you kindly make the following correction in our written submittal. On the second from last page (the first page of the two-page Conclusion) in the third paragraph delete the phrase "time weighted average" and substitute the word "ceiling".

Thank you.

Very truly yours,

M. J. Kleinfeld

M. J. Kleinfeld, Director
Commercial Planning

MJK:lads

ONLY COPY AVAILABLE

STATEMENT OF C. R. PELINO, DIRECTOR OF PROCUREMENT, STROMBERG-CARLSON CORPORATION; ACCOMPANIED BY DAVID LAVALETTE, GENERAL DYNAMICS CORPORATE MANAGER

MR. PELINO: Judge Myatt, gentlemen, my name is C.R. Pelino, Director of Procurement, of Stromberg-Carlson Corporation, 100 Carlson Road, Rochester, New York, a subsidiary of General Dynamics Corporation with headquarters in St. Louis, Missouri.

With me today I have my associate, David R. Lavalett who is the General Dynamics Corporate Manager for Safety and Environmental Health.

Stromberg-Carlson is a manufacturer and supplier of telecommunications equipment. We operate plants in Rochester, New York; Charlottesville, Virginia; Sanford, Florida; Ardmore, Oklahoma; and Camden, Arkansas. We employ a total of approximately 8500 employees.

Our product utilizes vast quantities of wire and cable which we manufacture utilizing polyvinyl chloride as an insulating material. We procure polyvinyl chloride in pellet form and manufacture the wire and cable utilized in our products, and provided to our customers.

We have been advised by our polyvinyl chloride suppliers that if the proposed standard is imposed without a time phased implementation schedule, it will cause the discontinuance of polyvinyl chloride production

If the OSHA Standard for exposure to vinyl chlofide is set so restrictive as to prevent or severely limit the manufacture of vinyl compounds, the effect would be a serious reduction or a halt in Stromberg-Carlson's wire and cable production.

Polyvinyl chloride is the only known acceptable insulation for the majority of our wire and cable at this time During the period when a shortage of petroleum threatened to limit the supply of polyvinyl chloride, an extensive search was made for substitute material and no direct substitute coul be found.

Our inability to supply our customers (The Independent Telephone Industry) with wire and cable and products using wire and cable would also in turn cause a deterioration of the telephone communication systems. All other manufacturers and suppliers of such equipment would be similarly affected. Additional telephone service would be restricted by the lack of available polyvinyl chloride and repairs and maintenance of existing systems would be severely limited.

From the foregoing, it is obvious that imposition of the standard as proposed without a time phased implementation schedule not only would severely impact the jobs of the Corporation, but would also severely impact the independent telephone industry.

Although we have not had sufficient time to quantify

the impact of the potential non-availablity of polyvinyl chloride material throughout General Dynamics Corporation, we have conducted a preliminary survey of all of our operations. The following are examples of potential impacts which resulted from that survey:

(a) At our Convair Division in San Diego, California we manufacture space launch vehicles. Polyvinyl chloride materials are used extensively in this operation. Non-availability would necessitate a major effort to rewrite specifications for alternate materials and would further require extensive testing to qualify such materials for high reliability usage in our space launch vehicles. This would stop production in those areas where the materials are used and would delay delivery of launch vehicles currently planned for national programs for NASA, the Defense Department and the communication satellites.

(b) Our Freeman Coal Company, which operates several mines in Illinois would be impacted by this standard due to the potential non-availability of conveyor belts, power cables and pipe, all of which utilize polyvinyl chloride extensively.

(c) Our Electric Boat Division at Groton, Connecticut manufactures and overhauls nuclear powered submarines for the U. S. Navy. Polyvinyl chloride materials are used for various purposes in this operation.

Non-availability would require identification and qualification for high reliability purposes of substitute materials, thus causing production delays, potential personnel layoffs and increased prices.

Based upon available data, we disagree with the immediate imposition of a no detectable level exposure limit. We suggest the establishment of a time phased implementation schedule that will permit the continued availability of polyvinyl chloride.

We believe that the proposed standard can be revised in such a manner as to afford adequate assurance against the adverse effects upon the health of employees while simultaneously permitting practicable application, and thus avoiding substantial adverse impacts upon our economy, our national defense, our telecommunications networks and our energy supplies.

Thank you.

JUDGE MYATT: Thank you.

Gentlemen?

MR. KUCHENBECKER: Mr. Pelino, do you have any figures as far as the percentage of your products made from polyvinyl chlorides?

MR. PELINO: In a telephone installation, all of the interconnectors use polyvinyl chloride as an insulating material. Cables are then jacketed with them also.

MR. KUCHENBECKER: Do you make any products that do not contain polyvinyl chloride?

MR. PELINO: Wire and cable products.

Cable products?

MR. KUCHENBECKER: Yes.

MR. PELINO: There is -- no, we do not at this point.

MR. KUCHENBECKER: I would like to investigate the area of substitutes.

MR. PELINO: Yes, sir.

MR. KUCHENBECKER: Whether you have looked into this at all.

MR. PELINO: Yes, sir.

MR. KUCHENBECKER: As far as replacement for the polyvinyl chloride.

MR. PELINO: Yes, we did.

MR. KUCHENBECKER: Are you familiar with the replacement for polyvinyl chloride?

MR. PELINO: Yes.

We looked at teflon.

We do not have equipment capable of handling teflon manufacturing.

Further, teflon, it is my understanding that teflon does not have the capability that PVC has for cable extrusion.

MR. KUCHENBECKER: Are you familiar with any uses of teflon as a replacement for --

MR. PELINO: Yes, I am.

MR. KUCHENBECKER: What are these?

MR. PELINO: These are used in higher temperature applications than PVC generally.

MR. KUCHENBECKER: For example, space launch vehicles, would this be an example?

MR. PELINO: I can't answer that.

I believe they do use others, they use other jacketing material for space launch other than PVC.

MR. KUCHENBECKER: Okay.

I would like to direct your attention to page 2 of your testimony.

In the third paragraph you made mention of a preliminary survey made of all of your operations.

MR. PELINO: Yes.

MR. KUCHENBECKER: How many operations, first of all were included in the survey?

MR. LAVALETTE: We have thirteen divisions and within the thirteen divisions there are a number of plants. We have a total employment magnitude of about 62,000 and we do about $7.5 billion in business.

This is the nature of the scope.

MR. KUCHENBECKER: Do these range from the production of coating for wire to what other products?

MR. PELINO: The products as mentioned here, the use

of bare belts, power cables, the use of wire for the space industry as well as the submarine work in Groton, Connecticut.

MR. KUCHENBECKER: All right.

Did you begin your survey with an assumption -- did you begin it, for example, on the assumption that the standard, the presently proposed standard if promulgated as is, would completely cut off the supply of polyvinyl chloride.

MR. LAVALETTE: Yes, that was the assumption.

We did two surveys.

One survey was way back early in the year, what kind of health hazard we have as a result of PVC exposure. That was one in-house.

There we came out very well because the only place we were actually handling things, fabricating, is in the Stromberg-Carlson Corporation where they're insulating the wires.

However, following that, we did a survey to see what would be the impact on our total business if PVC were no longer available to the market place.

MR. KUCHENBECKER: You mentioned this is a preliminary survey.

I have two requests:

First, could you make it available to us?

MR. LAVALETTE: Yes, I can.

I can present it to you when I go back to the office.

1515	7	Change "very many." to "to our higher management."
1516	21	Change "median level" to "immediately, and almost."
1517	6	Change "15," to "50,"
1518	22	Change "execute a license to work" to "enlighten us to what"
1519	6	Change "elicit" to "elucidate"
1519	16	Change "doctor" to "director"
1520	3	Change "Maltone" to "Maltoni"
1520	25	Change "earlier" to "earlier"
1523	14	Change "increase" to "decrease"
1526	1	Change "the same process," to "acetylene".
1526	6	Add "and our customers" after "."
1531	25	Add "this" after "in"
1539	17	Add "possibly teflon" after "chloride"
1541	1	Change "bare" to "conveyor"
1542	15	Change "excrusion" to "extrusion"
1543	3	Change "cart" to "carton"
1543	5	Change "PVC." to "VC."
1545	7	Change "assistants" to "Associates"
1561	7	Add "if" after ","
1561	20	Change "HECHMAN" to "HECKMAN"
1562	3	Change "capacity" to "advocacy"
1562	7	Change "Stanley" to "Sidney"
1562	9, 14 & 20	Change "HECHMAN:" to "HECKMAN:"
1562	17-18	Change "publication" to 'incorporation"
1562	22	Change "public" to 'membership"

EXHIBIT C.

5. If the questions of scientific judgment are challenged there should be ample provision for review by scientific committees nominated by the National Academy of Sciences.

5. The Administrator must recognize that agriculture is part of the total environment with which he is concerned.

6. The legislation must guard against legislative and administrative controls so restrictive that there is insufficient incentive for the chemical industry to continue with the research and development that is so essential to meet the critical pesticide needs of the future.

Legislation to carry out the intent of these points, in our judgment, is essential to protect the total public interest and achieve the kind of environment in which we want to live and work.

Mr. Chairman, if I could make just one comment about a report known as the Report of the Secretary's Commission on Pesticides and their Relationship to Environmental Health. Mr. Mrak is the chairman.

A number of witnesses, including those from the administration, have quoted from this report to substantiate the damage pesticides are doing to the environment. This report has a total of 14 official recommendations of the Commission. These official recommendations are the only part of this report agreed to by all of the members of the Commission; and they are found on pages 7 through 19 of the document report "Secretary's Commission on Pesticides and Their Relationship to Environmental Health, Parts I and II."

The remainder of this volume, Mr. Chairman, page 19 through page 77, includes the subcommittee reports. Mr. Mrak's committee has not reached any conclusion on the subcommittee reports.

Actually, from all of the witnesses you have heard, there is a great variation in scientific judgments on many of these matters. You can use parts of the subcommittee report and substantiate virtually any position that you could take. But I would submit that it might be important for those studying the record and developing the legislation, to recognize that only the 14 specific recommendations have been agreed to by the membership of the Commission.

That concludes my comments.

Senator ALLEN. Thank you, Mr. Lerch and Mr. Stokes. I don't believe I have any questions to ask and we do appreciate your appearing before the committee and giving us the benefit of your views.

Mr. LERCH. Thank you.

Mr. STOKES. Thank you.

Senator ALLEN. I have a meeting of the Rules Committee subcommittee at 1 o'clock. It is around the corner and down the hall. So I can stay until about 2 minutes to 1, at which time we will recess until 2 o'clock. So if you would proceed, Dr. Saffiotti.

STATEMENT OF DR. UMBERTO SAFFIOTTI, ASSOCIATE SCIENTIFIC DIRECTOR FOR CARCINOGENESIS, NATIONAL CANCER INSTITUTE, NATIONAL INSTITUTES OF HEALTH, BETHESDA, MD.

Dr. SAFFIOTTI. My name is Umberto Saffiotti, M.D., and I am associate scientific director for Carcinogenesis, National Cancer Institute, National Institutes of Health.

390

I am glad to have the opportunity to present my testimony on the problem of the evaluation of carcinogenic effects of pesticides.

The National Cancer Institute has committed a major effort to this problem, beginning in 1964, following the recommendations contained in the 1963 report on the "Use of Pesticides" prepared by the President's Science Advisory Committee. A large bioassay screening program for pesticides and other industrial chemicals was organized, using standardized test conditions and was conducted under contract at Bionetics Research Laboratories. It represented the first example of a large-scale screening program of this kind ever to be implemented. The results of the carcinogenesis tests were published in the Journal of the National Cancer Institute [42: 1101-1114, 1969].

A second level testing project on pesticides is now underway in the NCI carcinogenesis program through several contracts. This includes more extensive bioassays in rats and mice. These tests are conducted not only to detect hazardous environmental chemicals, but also to provide necessary information for the scientific evaluation of the mode of action of environmental carcinogens and preventability.

The problems of evaluating carcinogenic hazards from enviromental chemicals in general, and from pesticides in particular, have been the subject of two recent reports.

The first report was prepared for the Surgeon General, U.S. Public Health Service, by an ad hoc committee on the Evaluation of Low Levels of Environmental Chemical Carcinogens which was established at the National Cancer Institute and composed of distinguished scientists in the field of enviromental cancer. I served as Chairman of the Committee.

Publication of this report has been authorized by the Surgeon General, and the report has been submitted for consideration to the editorial board of the Journal of the National Cancer Institute for publication in that scientific journal.

The report discusses the major problems involved in the evaluation of carcinogenic risks, and therefore is directly relevant to the subject of the present hearings.

If agreeable to the subcommittee, I will submit the complete text of this report for the record.

Senator ALLEN. That will be accepted.

(The report referred to follows:)

EVALUATION OF ENVIRONMENTAL CARCINOGENS—REPORT TO THE SURGEON GENERAL, USPHS, APRIL 22,1970

180

(Ad Hoc Committee on the Evaluation of Low Levels of Environmental Chemical Carcinogens, National Cancer Institute, Bethesda, Md.)

MEMBERS OF THE AD HOC COMMITTEE ON THE EVALUATION OF LOW LEVELS OF ENVIRONMENTAL CHEMICAL CARCINOGENS

Umberto Saffiotti, Chairman, Associate Scientific Director for Carcinogenesis, Etiology, National Cancer Institute, Building 37, Room 3A21, Bethesda, Md.
Hans L. Falk, Associate Director for Laboratory Research, National Institute of Environmental Health Sciences, Research Triangle Park, N.C.
Paul Kotin, Director, National Institute of Environmental Health Sciences, Research Triangle Park, N.C.
William Lijinsky, Professor of Biochemistry, The Eppley Institute for Research on Cancer, University of Nebraska, College of Medicine, Omaha, Neb.

Marvin Schneiderman, Associate Chief, Biometry Branch, National Cancer Institute, Wisconsin Building, Room 5C10, Bethesda, Md.
Philippe Shubik, Director, The Eppley Institute for Research on Cancer, University of Nebraska, College of Medicine, Omaha, Neb.
Sidney Weinhouse, Director, Fels Research Institute, Temple University, School of Medicine, Philadelphia, Pa.
Gerald Wogan, Professor of Food Toxicology, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, Mass.
Staff Members: John A. Cooper, Executive Secretary, Richard R. Bates, James A. Peters, Howard R. Rosenberg, Elizabeth K. Weisburger, John H. Weisburger

INTRODUCTION

Establishment of this Ad Hoc Committee was requested on October 24, 1969, by the Deputy Assistant Secretary for Health and Scientific Affairs.

The task of the Committee is to review the problems relating to the evaluation of low levels of environmental chemical carcinogens, to consider the scientific bases on which such evaluations can be made, and to advise the Department of HEW on the implications of such evaluations.

The Committee, in addressing itself to the problems of environmental exposures to chemical agents from all sources, has considered the scientific criteria for evaluation of carcinogenic hazards.

Many previous recommendations on the criteria to be used for evaluating environmental chemical carcinogenic hazards have been made for specific sources of exposure or for specific groups of substances (e.g. food additives, pesticides, certain occupational carcinogens). In some cases this approach has led to an uneven assessment of risks from different sources and to an uneven approach to preventive measures.

The task of this Committee covers a broader area and includes an appraisal of the scientific criteria for evaluation of chemical carcinogenesis hazards in the total environment.

I. RECOMMENDATIONS

In full consideration of the past and present states of carcinogenesis investigation this Committee offers the following recommendations:

1.a. Any substance which is shown conclusively to cause tumors in animals should be considered carcinogenic and therefore a potential cancer hazard for man. Exceptions should be considered only where the carcinogenic effect is clearly shown to result from physical, rather than chemical, induction, or where the route of administration is shown to be grossly inappropriate in terms of conceivable human exposure.

b. Data on carcinogenic effects in man are only acceptable when they represent critically evaluated results of adequately conducted epidemiologic studies.

2. No level of exposure to a chemical carcinogen should be considered toxicologically insignificant for man. For carcinogenic agents a "safe level for man" cannot be established by application of our present knowledge. The concept of "socially acceptable risk" represents a more realistic notion.

3. The statement made in 1959 by the Food Protection Committee, National Research Council (see Appendix II) that natural or synthetic substances can be considered safe without undergoing biological assay should be recognized as scientifically unacceptable.

4. No chemical substance should be assumed safe for human consumption without proper negative lifetime biological assays of adequate size. The minimum requirements for carcinogenesis bioassays should provide for: adequate numbers of animals of at least two species and both sexes with adequate controls, subjected for their lifetime to the administration of a suitable dose range, including the highest tolerated dose, of the test material by routes of administration that include those by which man is exposed. Adequate documentation of the test conditions and pathologic standards employed are essential.

5. Evidence of negative results, under the conditions of the test used, should be considered superseded by positive findings in other tests. Evidence of positive results should remain definitive, unless and until new evidence conclusively proves that the prior results were not causally related to the exposure.

6. The implication of potential carcinogenicity should be drawn both from tests resulting in the induction of benign tumors and those resulting in tumors [redacted] are [redacted] mali[redacted]

7. The principle of a zero tolerance for carcinogenic exposures should be retained in all areas of legislation presently covered by it and should be extended to cover other exposures as well. Only in the cases where contamination of an environmental source by a carcinogen has been proven to be unavoidable should exception be made to the principle of zero tolerance. Exceptions should be made only after the most extraordinary justification, including extensive documentation of chemical and biological analyses and a specific statement of the estimated risk for man, are presented. All efforts should be made to reduce the level of contamination to the minimum. Periodic review of the degree of contamination and the estimated risk should be made mandatory. 181

8. A basic distinction should be made between intentional and unintentional exposures.

a. No substance developed primarily for uses involving exposure to man should be allowed for wide-spread human intake without having been properly tested for carcinogenicity and found negative.

b. Any substance developed for use not primarily involving exposure in man but nevertheless resulting in such exposure, if found to be carcinogenic, should be either prevented from entering the environment or, if it already exists in the environment, progressively eliminated.

9. A system should be established for ensuring that bioassay operations providing data upon which regulatory decisions are made be monitored so that their results are obtained in accordance with scientifically acceptable standards.

10. A unified approach to the assessment and prevention of carcinogenesis risks should be developed in the federal legislation; it should deal with all sources of human exposure to carcinogenic hazards.

11. Clear channels should be identified for the regulatory function of different Government departments and agencies in the field of cancer prevention. Establishment of a surveillance and information program would alert all concerned Government agencies to the extent and development of information on formation on carcinogenic hazards.

12. An ad hoc committee of experts should be charged with the task of recommending methodos for extrapolating dose-response bioassay data to the low response region (1-100000% to 1-10000000%). The low doses corresponding to the responses in this range are the ones which have direct relevance to the human situation.

II. BACKGROUND

Knowledge of cancer causation by chemicals originates from clinical observations, going back as far as 1775 with Pott's discovery of soot as the causative agent in chimney sweeps' cancer. Several major classes of carcinogenic agents were first discovered by their effects on man. Experimental animal models for the determination of the potential carcinogenic activity of chemicals were only developed in the last 50 years, and most of them have been studied only in the last 20 years.

The effects of carcinagens on tissues appear irreversible. Exposure to small doses of a carcinogen over a period of time results in a summation or potentiation of effects. The fundamental characteristic which distinguishes the carcinogenic effect from other toxic effects is that the tissues affected do not seem to return to their normal condition. This summation of effects in time and the long interval (latent period) which passes after tumor induction before the tumor becomes clinically manifest demonstrate that cancer can develop in man and in animals long after the causative agent has been in contact and disappeared.

It is, therefore, important to realize that incidences of cancer in man today reflect exposure of 15 or more years ago; similarly, any increase of carcinogenic contaminants in man's environment today will reveal its carcinogenic effect some 15 or more years from now. For this reason it is urgent that every effort be made to detect and control sources of carcinogenic contamination of the environment well before damaging effects become evident in man. Similar concepts may apply to the needs for evaluation of other chronic toxicity hazards. Environmental cancer remains one of the major disease problems of modern man.

An agent which is causally related to the occurrence of cancer in man or animals is defined as a carcinogen or oncogen. The number of known carcinogenic agents includes several groups of viruses, various physical factors, and hundreds of chemicals.

Viruses of different types are known to induce cancer in animals; none has yet been proven to cause cancer in man. If specific viruses are proved to be causally 182

lated to cancer induction in man, the frequency of certain human tumors might e reduced in the future by immunization procedures.

Physical factors are known to cause cancers in man and animals. For example, traviolet radiation causes skin cancer, and ionizing radiation cancer of various rgans (e.g. leukemias, lung cancer, bone sarcomas, skin cancer). Exposure to a background level" has been widely considered as unavoidable and, in the case ultraviolet light, even necessary as an integral part of our natural environ- ent. Strong epidemiologic and experimental evidence indicates the existence f a direct dose-response relationship between exposure to radiation and carcino- enic effects. Tolerance levels have been suggested for various forms of radiation nd health benefits have been realized from their application. Evaluation of adiation hazards has been approached through measurement of the total cumu- tive dose of radiation exposure. Some carcinogenic radiation hazards, such as ertain occupational exposures (e.g. radiation in uranium mines), are still t effectively controlled.

Chemicals of many classes produce cancer in a large number of organ sites in nimals. Cancers in man are known to be caused by several individual chemicals nd by materials composed of mixtures of chemicals. Chemical carcinogens have en shown to act by surface contact with skin or mucosae, by inhalation, by in- stion, and occasionally by injection or implantation (medical or accidental). hemicals may induce cancer at the site of initial contact (e.g. skin cancer from dimepelides), the site of metabolism and detoxification (e.g. liver or kid- y cancer from aflatoxin or nitrosamines), or the site of excretion (e.g. urinary ynuclear hydrocarbons), the site of selective localization (e.g. bone cancer adder cancer from aromatic amines). A complex and often uneven approach to e problem of preventing exposure to chemical carcinogens has developed over e years. It has become increasingly obvious that the hazard from a single chem- l carcinogen cannot be evaluated out of context of the total environmental ex- sure (v). Estimation of the "cumulative carcinogenic dose" resulting from all ssible chemical carcinogens or even from all sources of a single type or class chemical carcinogens is presently impossible.

Prevention of exposure to known carcinogenic chemicals depends largely on s ability to control their entry into the environment. Certain chemical car- gens are natural products (e.g. metabolites of the amino acid tryptophan) or turally occurring contaminants (e.g. mycotoxins). Others are formed in the ressing of natural products. Many, such as polynuclear hydrocarbons (e.g. nzo[a]pyrene), occur almost ubiquitously in our modern industrialized en- nment. They derive from most sources of organic combustion. A class of very ent carcinogens discovered only in recent years, the N-nitrosamines, include mpounds that may be formed in the environment from nitrites and secondary nes. Many other known chemical carcinogens have been introduced as syn- tic materials or by-products into man's present environment through a wide e of newly-developed industrial processes. Some of these, such as food addi- s, medicinal products, cosmetics, and certain household products or pesticides, e developed for human use. Several carcinogens derive from products such bacco smoke, developed exclusively for human use. In other cases chemical cinogens not intended primarily for human exposure are introduced into the ral environment and eventually come in contact with its inhabitants; many stances (certain polynuclear hydrocarbons, pesticides, metals, dusts, and s, etc.) gain widespread environmental distribution, thereby becoming pol- nts of the air, soil, water, and food. Prevention of exposure to this broad trum of chemical carcinogens must take a variety of forms.

he production of chemicals recognized as carcinogens for uses involving ntional human exposure can be identified and effectively eliminated. Ex- ons to this approach should be made for substances that involve a well- ed health benefit (e.g. certain chemotherapeutic drugs). Use of such stances should be accepted on the basis of extraordinary evidence that their th benefit outweighs their risk.

he production of specific carcinogenic chemicals for uses that do not pri- ly involve an intentional exposure of man, but which result in such en- nmental contamination that extensive human exposure becomes inevitable, t also be controlled. The most effective prevention of exposure in man is the nation of carcinogen production, or control of entry into the environment. large group of chemical carcinogens (e.g. combustion products, myco- ns, and other natural products) is widely disseminated in the environment [redacted] sources that [redacted] part[redacted]ntrol[redacted]or [redacted]cont[redacted]nts, [redacted]

well as for products which have been widely spread in the environment before their carcinogenicity was recognized, the only possible approach to exposure reduction is to monitor their environmental distribution and subsequently minimize their contact with humans.

Modifying factors are known to condition the development of neoplasia in man and animals. They can act intrinsically or extrinsically (e.g. hormonal imbalances, metabolic characteristics or abnormalities, caloric intake, dietary factors). Understanding of their specific effects in man, however, is still not adequate to serve as a reliable basis for preventative action.

Interactions among multiple factors have received limited attention to date. There are well-documented instances in animal studies of strong synergistic effects produced by chemicals in combination with radiation, viruses, or other chemicals. The epidemiological patterns of certain human cancers implicate combined effects of multiple agents (e.g. inhalation of radon and radon daughters in uranium mines and cigarette smoking).

The types of cancer in man that are due, directly or indirectly, to extrinsic factors are thought to account for a large percentage of the total cancer incidence (2). These include tumors of the skin, the respiratory, gastrointestinal and urinary tracts, hormone-dependent organs (such as the breast, thyroid, and uterus), and the hemopoietic system. During the past decade considerable progress has been made in the detection of carcinogenic agents and the analysis of their biological effects. New approaches to the interpretation of quantitative relationships between exposures and carcinogenic effects in man and animals are being developed. It is estimated, therefore, that the majority of human cancers are potentially preventable (2).

III. ANIMAL BIOASSAY RESULTS AND EVALUATION OF RISKS IN MAN

In order to evaluate the hazard of a chemical for man, one must extrapolate from the animal evidence. It is essential to recognize that no level of exposure to a carcinogenic substance, however low it may be, can be established to be a "safe level" for man. This concept, put forward in the 1950's, remains true in 1970. The current legislation in the field of food additives, with its "anticancer clause", is based on this principle (Federal Food, Drug and Cosmetic Act, as amended, Sect. 409 (c) (3) (A)).

The reasons for retaining this "anticancer clause" were effectively summarized in 1960 by Secretary of Health, Education and Welfare Arthur S. Flemming in testimony to Congress (3) on the subject of extending the clause to cover the use of food colors, with the following statement.

"The rallying point against the anticancer provision is the catch phrase that it takes away the scientist's right to exercise judgment. The issue thus made is a false one, because the clause allows the exercise of all the judgment that can safely be exercised on the basis of our present knowledge. The clause is grounded on the scientific fact of life that no one at this time, can tell us how to establish for man a safe tolerance for a cancer-producing agent.

"Until cancer research makes a breakthrough at this point, there simply is no specific basis on which judgment or discretion could be exercised in tolerating a small amount of a known carcinogenic color on food additive.

"As I pointed out in my original testimony, the opposition to inclusion of an anticancer clause arises largely out of a misunderstanding of how this provision works. It allows the Department and its scientific people full discretion and judgment in deciding whether a substance has been shown to produce cancer when added to the diet of test animals. But once this decision is made, the limits of judgment have been reached and there is no reliable basis on which discretion could be exercised in determining a safe threshold dose for the established carcinogen.

"So long as the outstanding experts in the National Cancer Institute and the Food and Drug Administration tell us that they do not know how to establish with any assurance at all a safe dose in man's food for a cancer-producing substance, the principle in the anticancer clause is sound.

"I want to emphasize the statement I made on January 26 that the Food, Drug, and Cosmetic Act, as it now stands, will be enforced to prohibit the addition of cancer-producing substances to food unless a law should be passed directing us to follow another course of action.

"[redacted] thou[redacted] have [redacted] authority in the law, we urge the Congress to [redacted]

"Even though we have this authority in the law, we urge the Congress to

...in with the executive branch to give added assurance to the consuming public ...y directing the anticancer clause in the proposed color additives amendment. "Again, we say, however, that we believe the issue is so important that the ...lected Representatives of the people should have the opportunity of examining ...e evidence and determining whether or not the authority should be granted."

The scientific basis on which the Government's position was established in ...0) remains valid. The progress of knowledge in carcinogenesis in the last ...decades has only strengthened the points made in Secretary Flemming's testi...ony.

IV. DETECTION OF LOW LEVELS OF CARCINOGENS IN THE ENVIRONMENT

To establish the presence of "low levels of carcinogen in the environment" ...quires that 1) the presence of the material in question be recognized in the en...ronment and 2) the material be recognized as carcinogenic. To evaluate the ...pact of a chemical in the human environment, it is useful to prepare an "en...ronmental profile" to reflect the distribution of this material in time and space. ...ailure to detect the presence of a compound implies only that the compound ...present, if at all, in concentrations below the detectable limit of the analytical ...ethod used. These "sub-detection levels" cannot be differentiated from "zero". ...rom the distribution profile and additional information on the conditions of ...ake in man the approximate level and extent of exposure for population seg...ents can be estimated.

In recognizing a chemical as a carcinogen, the limiting factor is the sensi...vity and specificity of the bioassay system used. A bioassay system designed to ...etect tumor induction only at or above a given level under the conditions of the ...st (e.g. a 25% incidence of a specific tumor type) will fail to reveal car...inogenicity below that level. Compounds whose carcinogenic effects fall below ...ecific bioassay detection limits must not be considered innocuous. Such mate...ials must be characterized as presenting a carcinogenic risk no greater than ...at defined by this lower limit.

Methodology for the determination of chemical contamination in the environ...ent and of biological activity of carcinogens are discussed in the following ...ections.

1. *Chemical Detection Methods*

Methods for detection of low levels of carcinogens in the environment have in...reased in accuracy and reliability over the past several years. The lower limits ...f detection for different types of known carcinogenic substances are extremely ...ariable, extending over several orders of magnitude from very sensitive methods ...e.g. 1 part per billion of benzo(*a*)pyrene or aflatoxin) to rather insensitive ones ...e.g. for aromatic amines). In principle, analytical methods should be capable of ...etecting carcinogenic materials at any level or in any condition which has relevance to human exposure. For this reason, increasingly sensitive analytical techniques are needed, and indeed many have been developed over the last 10 years. Appendix I summarizes the present state of the art in the analytical determination of low levels of environmental carcinogens (*1*) and indicates the lower limits of detection available today, in contrast with those of 1959. Much of the improvement in methodology is attributable to the application of gas-liquid chromatographic techniques. Within the next few years sizable additional improvements in the sensitivity of analytical methods are likely to be achieved.

It is important to consider how widely the new analytical methods can be applied for the detection of a given carcinogenic contaminant in different materials. While highly sensitive analytical methods can be devised to detect a chemical in specific materials, these same methods might be powerless in the analysis of the same chemical from other source materials (e.g. dimethylnitrosamine can be detected in the alcoholic beverages at 1 ppb, but in foods only at 10–100 ppb). An uneven evaluation of the sources of environmental contamination may result. Development of widely applicable procedures will provide a more balanced evaluation of environmental contamination.

2. *Biological Detection Methods*

The carcinogenic activity of materials can only be detected by long-term biological tests. At the present time the chemical structure or physico-chemical properties of a compound do not provide a reliable basis for prediction of freedom from carcinogenic activity. Several structure-activity correlations are valu... [redacted] ...dicat... [redacted] ...ble ... [redacted] ...ogen... [redacted] ...of a ... [redacted] ...ound... [redacted] ...non... [redacted] ...be ... [redacted]

used to classify the compound as non-carcinogenic. Short-term bioassays that determine the effect of certain chemicals on selected biologic targets have not been reliable for prediction of carcinogenic activity.

The present state of the art requires long-term bioassays in mammalian species for the experimental identification of carcinogenic activity. United States law requires that food additives and various other materials be tested in animals by the intended route of human exposure. Similar tests have not been required for some materials to which humans are exposed by other than the oral route. The expanding production and use of chemicals in household products results in extensive human exposure (via the skin and respiratory tract) to dusts, and aerosols; little information is available on the chronic toxicity of these materials by these routes of administration. It would not be wise to wait for the results of these "experiments in man" before instituting animal experimentation.

Bioassays are always performed on a number of animals which is extremely small when compared with the millions of humans exposed to most environmental carcinogens. Such studies can only detect carcinogenic effects resulting in fairly high incidences. For example, an observed outcome of no tumors in a test group of 100 animals, as well as in 100 negative controls, only provides assurance, at the 99 percent probability level, that the true tumor risk is under 4.5 percent. The maximum probable risk is 0.46 percent if groups of 1000 animals are used. It would require tumor-free results in 450 animals to establish with like probability that the risk is under 1 percent (4).

The assessment of the carcinogenic activity of a chemical depends on a variety of parameters. These include not only the total number of tumors induced but also their multiplicity, latent period, morphologic type, and degree of malignancy. The induction of tumors diagnosed as benign as a result of treatments has been interpreted by certain groups in the past as not sufficient to demonstrate a "carcinogenic" effect. This is a dangerous position since few, if any, substances are known to have produced only benign tumors and no malignant ones when properly and repeatedly tested. This has been pointed out in the Report of the Subcommittee on Carcinogenesis of the FDA Committee on Protocols for Safety Evaluation (5).

The important scientific problem of defining the sensitivity of a bioassay system used for testing materials of unknown activity has received insufficient attention. The interpretation of both positive and negative findings is strictly dependent on such definition as well as on the results obtained in negative, vehicle, positive and colony control animals. A bioassay result is meaningful only when accompanied by a statement of the sensitivity and specificity of the bioassay design used. An observed incidence of a given tumor type in a test group has no meaning without adequate information on the appropriate controls. Far too little work has been done using adequate positive controls. Lack of tumor response in a given experimental system cannot be interpreted as negative evidence if positive controls also yield negative results or if no positive controls have been included to show that the experimental system used is appropriate.

A body of knowledge has developed over the years on the response of experimental animals to chemical carcinogens. Several committees of experts in the field of carcinogenesis convened by national and international bodies over the past 15 years have formulated general principles for performance and evaluation of carcinogenesis studies in animals. The recommendations put forth by these committees have shown remarkable unanimity (2, 5–10) and are widely accepted in principle by the scientific community (11–15). General requirements for testing procedures, which have been outlined by these groups, include specification of criteria for the following:

1. selection of materials to be tested;
2. chemical and physical characterization of the test materials;
3. selection of appropriate animal species and group size; and
4. choice of appropriate routes and levels of administration.

In addition, recommendations concerning the lifetime maintenance and pathological examination of experimental animals have been outlined.

Two principles are recognized as fundamental to the evaluation of carcinogenesis bioassays.

1. The minimum requirements for carcinogenesis bioassay should include adequate numbers of animals of at least two species and both sexes with adequate positive and negative controls subjected for their lifetime to the

administration by appropriate routes of a suitable dose range of the test material, including doses considerably higher than those anticipated for human exposure.

2. Any substance which is shown conclusively to produce tumors in animals, when tested under these conditions, should be considered potentially carcinogenic for man.

V. QUANTITATIVE RELATIONSHIPS

The major new argument presented today against the "anticancer clause" is that the marked increase in sensitivity of many analytical methods makes it possible to detect low levels of carcinogens in a broader segment of the environment and that, therefore, the immediate enforcement of regulations requiring a zero tolerance becomes more difficult, in some instances impossible.

New and very potent classes of chemical carcinogens, such as aflatoxin and nitrosamines, have been detected in the environment. Striking examples of potentiation in cancer induction have been reported in experimental animal tests and in epidemiologic observations. Bioassays have revealed the carcinogenicity of such widespread environmental chemicals as DDT and cyclamate, to which a large majority of the American population has been exposed.

In contrast to the analytical methods, bioassay methods have remained tools of low sensitivity, capable only of detecting the highest peaks of carcinogenic activity. The factor which limits bioassay sensitivity is usually the small number of test animals used. If the bioassay design has a low probability of detecting carcinogenic effects produced by hazards at levels comparable to those present in environmental samples, then tests at such levels are wastes of time, effort and money. The need to test dose levels higher than those found in the environment is thus founded. Some substances, on the other hand, are potent carcinogens in animal test systems at levels not currently detectable in the environment. An example is provided by the recent evidence on aflatoxin. Its lowest analytically detectable level is 1 ppb. One hundred percent tumor incidence was produced in rats by a dose as low as 15 ppb. in the diet. Experiments now under way suggest that aflatoxin, when fed to rats at the lowest detectable level (1 ppb), is still carcinogenic (*16*). It has already been demonstrated to be carcinogenic at 1 ppb in the trout. These data indicate that aflatoxin may be present in food at undetectable levels and still be capable of producing cancer incidences so high as to be detectable in tests involving relatively small numbers of experimental animals.

It is impossible to establish any absolutely safe level of exposure to a carcinogen for man. The concept of "toxicologically insignificant" levels (as advanced by the Food Protection Committee of the NAS/NRC in 1969; see Appendix II), of dubious merit in any life science, has absolutely no validity in the field of carcinogenesis. Society must be willing to accept some finite risk as the price of using any carcinogenic material in whatever quantity. The best that science can do is to estimate the upper probable limit of that risk. For this reason, the concept of "safe level for man", as applied to carcinogenic agents, should be replaced by that of a "socially acceptable level of risk".

While science can provide quantitative information regarding maximum risk levels, the task ultimately selecting socially acceptable levels of human risk rests with society and its political leaders. The evaluation of the balance of benefits and risks, required for such a decision by society, should not be the result of uninformed guesswork but should be reached on the basis of complete and pertinent data, social as well as scientific. It is necessary, therefore, to define the extent in the processes of interpreting animal response data (Appendix III) and subsequently extrapolating them to man (Appendix IV). The principle of zero tolerance should be applied in all but the most extraordinary of cases.

VI. CONCLUSION

Modern society has been extremely fortunate—given the technical limits on detection of carcinogenic effects—that at least some environmental carcinogens have been identified. So-called negative data, obtained in bioassays often incapable of detecting effects below the 10 percent level, are grossly inadequate to give assurance of safety for man. Information on about 2,500 compounds tested for carcinogenic activity up through 1960 has been compiled and published [illegible]. Data on tests reported since 1960 will be published shortly. It is estimated that data on 3,500 previously unevaluated chemicals will be included in the

forthcoming volume. It is seen, then, that about 6,000 chemicals are documented as having undergone carcinogenesis bioassay to date. Many of the referenced tests, however, were inadequate according to presently recommended standards.

If this nation wishes to identify a large segment of existing and potential carcinogenic hazards, it must institute a comprehensive program involving a concert of activities. Scientific and technical plans for the development of methodological standards should be provided by experienced agencies in collaboration with qualified advisors. It is essential that the objectivity of these advisors not be damaged by any conflicting interests.

Resources needed for the extensive bioassay screening of environmental chemicals will be considerable. In addition to the myriad of substances presently in the environment, several thousand new compounds are introduced each year. Up to 20,000 materials should be tested for carcinogenicity as a first screening of the environment. Testing 20,000 compounds by bioassay would cost about $1 billion. This estimate would increase accordingly for the more extensive testing required in less superficial evaluation. Yet even were such funds available today, they could not nearly be spent effectively. Bioassay laboratory and professional resources are just not available in quantities capable of supporting a huge testing program. A great deal of "tooling up" is prerequisite to any such expanded level of effort.

Because the latent period in human carcinogenesis is so long, epidemiologic evidence develops only over periods of 15 to 20 years. Timely decisions to exclude materials from uses involving exposure to man, therefore, must be based solely on adequately conducted animal bioassays. Retrospective human evidence of risk must not be allowed to show itself before controlling action is taken. Chemicals should be subjected to scientific scrutiny rather than given individual "rights"; they must be considered potentially guilty unless and until proven innocent. Valid evidence must come from biological assays; every bioassay report should include a statement of its limits of sensitivity. Experimental design should provide for reproducibility of test results. Since the bioassay plays such a key role in a total carcinogen control scheme, more effort must be devoted to setting standards for both the performance of tests and the interpretation of results. Only given good bioassay data can science possibly provide sound information to those who are charged with making social decisions regarding the acceptability of carcinogenesis risk levels.

An effective program to protect man from the mass of environmental cancer hazards is within reach. No more time should be allowed to pass before the recommendations set forth in this report are applied to reality.

Appendix I—Chemical Detection Methods: Analytical Procedures and Their Sensitivity

A review of these methods has recently been published by the International Union Against Cancer (*1*). A brief summary follows.

I. POLYNUCLEAR COMPOUNDS

Area of concern.—Carcinogenic materials falling into this general class are, at least potentially, produced under all circumstances where pyrolysis of organic substances occurs. Many members of this chemical group are carcinogenic. Analytical methods provide separation and determination of benza(*a*)pyrene, dibenz(*a,h*)anthracene and dibenz(*a,h*)acridine and other compounds commonly found together in combustion products (tars, soots, petroleum derivatives, etc.).

Analytical methods.—Acceptable analytical methods must be capable of separating and measuring at least the specific materials mentioned above. At present the methods which appear most effective depend on absorption, fluorescence spectrometry, mass spectrometry, or gas-liquid chromatography for quantification and one of several chromatographic techniques for separation.

Sensitivity.—The minimum concentration of polynuclear compounds which may be determined by present methods is approximately 1 part of an individual compound per billion (1959 sensitivity approximately 100 ppb.).

II. CHLORINATED HYDROCARBONS

Area of concern.—The chlorinated hydrocarbons have been and still are extensively used as industrial solvents and reactive intermediates. Carbon tetrachloride is a well-known liver toxin and is suspected of being a carcinogen. During the past decade, other chlorinated hydrocarbons have been widely used as persistent pesticides and general exposure of man has occurred. DDT, DDD, aldrin, dieldrin and heptachlor have been reported as carcinogenic in animals.

Analytical methods.—Current methods are based on extraction and condensation followed by separation and quantification by gas chromatography.

Sensitivity.—The advent of electron capture detectors has made methods of analysis for this class of compounds extremely sensitive. Current minimum levels of detection are about 0.1 ppb (1959 sensitivity approximately 10 ppb).

III. AROMATIC AMINES AND CHEMICALLY RELATED COMPOUNDS

Area of concern.—For purposes of this discussion the "aromatic amine" are considered to include not only the substituted aromatic amines but also those compounds (nitro-, azo-, or hydroxylamine compounds) capable of being converted into aromatic amines by metabolic processes. Occupational exposure and exposure through the air, foodstuffs, plastics, and drinking water pose threats of carcinogenic hazards for humans. One must also consider the contribution to the carcinogenic load of endogenous aromatic amines such as certain tryptophan metabolites.

Analytical methods.—General methods for the determination of "total aromatic amines" are of little value because of the wide variation in carcinogenicity between members of the class. Estimation of specific substances is generally effected by their conversion to primary aromatic amines and then to azo dyes by diazotization and coupling; the azo dyes are separated chromatographically and estimated colorimetrically.

Sensitivity.—Methods for detection of members of this general class vary widely in their sensitivity due to the diverse properties of the compounds included. Azo compounds are easily estimated at sensitivities on the order of 10–100 ppb, while aromatic amines and hydroxylamine can be estimated with precision only at levels of about 1 ppm (1959 sensitivity about the same).

IV. N-NITROSO COMPOUNDS

Area of concern.—During recent years many members of this class of chemicals (nitrosamines and nitrosamides) have been recognized as highly potent carcinogens capable of inducing cancer in a variety of organ sites. There is a growing concern that these materials may represent significant cancer hazards for man. These compounds first came to our attention as a result of their utilization as industrial solvents and chemical intermediate, but they may be widely distributed at low levels in a variety of natural products. It is suspected that they may even be formed by the interaction of natural products in the organism during food preparation.

Analytical methods.—Methods in current use depend on the extraction of these substances from a variety of starting materials and cleanup of the extract by various chromatographic techniques followed by quantification of the individual compounds by gas-liquid chromatography. Specific methods have only been developed for a few individual members of the class. No satisfactory methods for the measurement of nonvolatile nitroso compounds have yet been developed.

Sensitivity.—Minimum detectable levels for the individual compounds are at present about 100 ppb (1959 sensitivity=relatively insensitive colorimetric or polarographic procedures).

V. AFLATOXINS

Area of concern.—Human exposure to the aflatoxins occurs principally by way of contaminated foods. It is now clear that such contamination can occur in essentially any food commodity, when harvest, storage, or transport conditions permit the growth of specific spoilage molds.

Analytical methods.—Currently used methods involve extraction and cleanup followed by identification of the compounds on thin layer chromatograms viewed under long wave ultraviolet light.

Sensitivity.—Although problems are associated with all of the presently available techniques, detection is possible at the level of 1 ppb (1939 sensitivity=problem was unrecognized).

VI. INORGANIC SUBSTANCES

Area of concern.—A number of inorganic substances of common occurrence in the environment have been reported in the past to be carcinogenic in man or certain animal species. They include compounds containing the following elements: arsenic, beryllium, cadmium, chromium, cobalt, lead, nickel, silver, titanium.

Analytical methods.—Analysis of the metals is performed today by atomic absorption spectroscopy after apropriate extraction and concentration procedures.

Sensitivity.—The lower limits of detection for the metals listed are on the order of 1 ppb (1939 sensitivity=about 10 ppb).

VII. ASBESTOS

Area of concern.—This substance is a fibrous particulate material produced in vast amounts for many industrial uses and recently found to be a widespread air pollutant. Major monitoring needs concern its presence in the general atmosphere and as an industrial dust.

Analytical methods.—Although sensitive methods are available for the detection of the elemental components of this substance, no specific chemical methods for identification of asbestos itself are available. Its estimation is still based on microscopic identification and count of asbestos particles in measured samples.

Sensitivity.—Extremely low and little improved since 1939.

VIII. OTHERS

A number of other carcinogens, belonging to a wide variety of chemical classes, need to be analyzed with specific methods. Their enumeration exceeds the limits of the present discussion. It is also necessary to improve the detection of materials which are recognized as potential sources of carcinogens and for which no adequate analytical methods are presently available (e.g. secondary amines and nitrites, which may interact to form nitrosamines).

APPENDIX II—COMMENTS ON 1969 REPORT OF THE FOOD PROTECTION COMMITTEE

This Committee has examined a report entitled "Guidelines for Estimating Toxicologically Insignificant Levels of Chemicals in Food" published in 1969 by the Food Protection Committee—Food and Nutrition Board of the National Academy of Sciences—National Research Council. It records its strong objections to the principles expressed in that report, which states that natural or synthetic substances can be considered safe without experimental support under certain vaguely-stated conditions.

The Food Protection Committee Report assumes that ". . . a level of insignificance may be determined if: (1) There are available adequate scientific studies that establish safe levels of similar magnitude for at least two analogous substances. (2) The acute or subacute toxicity of the new substance and two analogous substances is of the same nature and degree." For "Chemicals in Commercial Production" it recommends that: "If a chemical has been in commercial production for a substantial period, e.g. 5 years or more, without evidence of toxicological hazard incident to its production or use, if it is not a heavy metal or a compound of a heavy metal, and if it is not intended for use because of its biological activity, it is consistent with sound toxicological judgment to conclude that a level of 0.1 ppm of the chemical in the diet of man is toxicologically insignificant."

To assume (a) that a 5-year period of use has any meaning for the evaluation of chronic toxicity in man, (b) that any chemical may be considered safe simply because two "analogous substances" are "safe", and (c) that acute or subacute toxicity are reliable guidelines for evaluating long-term toxicity is to display a lack of understanding and appreciation of factors involved in chronic toxicity, particularly of the irreversible and delayed toxic effects which occur in carcinogenesis.

Since the purpose of the report is to recommend guidelines and priorities for selecting chemicals for human use without direct experimental toxicological evaluation, the lack of consideration of irreversible long-term toxic effects (which would not be ruled out by the suggested criteria) makes the suggested approach practically inapplicable and potentially dangerous.

Appendix III—A Method for Determining the Dose Compatible With Some "Acceptable" Level of Risk

(Contributed by Dr. M. A. Schneiderman)

Introduction

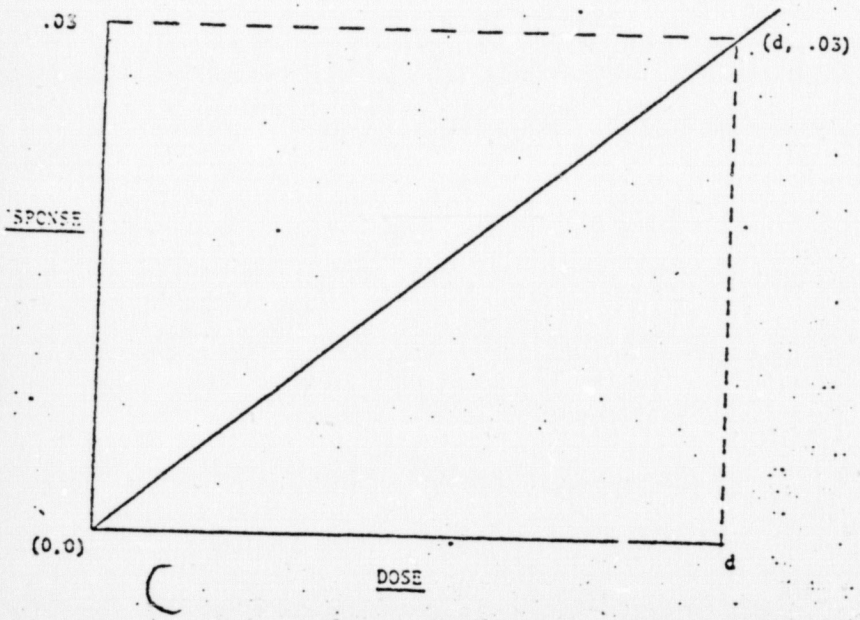
In establishing the concept of an "acceptable" risk dose (ARD) we must bear in mind that the dose level arrived at gives a tolerable risk *only for the species for which the extrapolation has been made*. Given this caveat, to make a conservative* estimate of an ARD, two assumptions need to be made:

A. The dose-responsive curve at low response levels is concave upward (e.g. the left-hand tail of the common S-shaped curve). The upper (dose) limit of this S-shaped curve is a straight line going through the 0,0 point (no dose= no response). The true dose-response curve is shallowest at this point.

B. A given set of data will provide an estimate for the upper limit of the other point through which the straight line must pass (which then gives the upper limit of the slope of the dose-response curve).

As an example of the use of the ARD concept, let us suppose that we have observed 100 control animals and 100 treated animals at a given dose rate, d, and have seen no tumors in either group. The upper 95% confidence limit on such a result is 3/100 (i.e. the data are consistent with the statement that with true response rate of .03, we might expect to see zero tumor incidence in 95% of similar experiments). If the socially "acceptable" risk selected is to be one additional cancer case for each hundred thousand persons, it is now desired to establish an ARD which will produce a maximum lifetime tumor incidence of 10/(100,000). We can then construct the graph:

*The procedure outlined here is essentially the "one-hit" procedure and gives a somewhat more conservative answer than the procedure of Mantel and Bryan (4).



The line connecting the (0,0) point with the (d, .03) point has

$$\text{Slope} = .03/d$$

and the equation of the line is:

$$\text{Response} = (\text{Dose})(.03/d)$$

If we wish to determine some dose (e.g. the ARD) which would be predicted to yield a response of not more than $1 \cdot 10^{-5}$ we would write:

$$\text{Dose} = (1 \cdot 10^{-5})(d/.03) = 3.3 \cdot 10^{-4}d)$$

ARD

Working towards an ARD this way has several consequences:

a. An increase in the experimental size (at the same dose, d, and with the same experimental result, i.e. no tumors) will reduce the upper confidence limit. Thus, if there were 200 animals in each contrast group, the upper 95% confidence limit would be about halved and the estimated ARD would be doubled.

b. An increase in the dose, d, at which the result (no tumors) occurred would increase the estimated ARD in direct proportion to the tested dose. Thus, if the initial experiment had been conducted at twice as high a dose *with the same result*, the estimated ARD would be twice as high as that determined from this experiment.

The procedure outlined has the virtue of lending greater credence to conclusions reached on the basis of larger experiments. Higher estimated ARD's will be found under such circumstances and the confusion between "not statistically significantly different", and "not different" can be avoided.

It must be stressed that these calculations do not establish an "acceptable risk dose" for man. The procedures do not tell us for example what factors are required to extrapolate from animal to man, although the following factors must certainly be considered.

1. Dose-response curves in man (a grossly non-homogeneous animal) are likely to be much shallower than dose-response curves in experimental animals. This implies higher levels of response at low doses for man, other things being equal.

2. It is possible that even the use of the straight line between the 0,0 point and some experimentally determined dose-response point (plus upper confidence limit) may yield too high an estimated ARD for man.

3. Whether the proper blow-up factor for doses in man should be on a mg/kg, or mg/M² basis, or any other basis, must be established independently.

4. Nothing in this procedure would enable one to know where the dose-response curve for man belongs along the dose scale in comparison with the dose-response curve for the experimental animal. If man's curve lies much to the left of the experimental animal's curve, then an ARD for the experimental animal may be a gross overdose for man.

Where several species are studied, it would seem safest in the absence of better information, to accept for man an ARD no greater than the lowest ARD dose derived from the results for the several species. It has been suggested that an appropriate "safety factor" for man should involve a reduction in the ARD for animals by a factor of 100 to allow for species' differences, another factor of 100 to allow for interactions with other carcinogens, and another factor of 100 to hedge against the incorrect choice of "blow up" (weight, or surface area) from animals to man. This would imply an ARD in man of about 1×10^{-6} the ARD in animals.

INSTRUCTIONS FOR CALCULATION OF THE ARD USING 95% AND CONFIDENCE LIMITS

(Experiment in which no animals in either treated or control group show a response, e.g. development of a tumor): We need the following values:

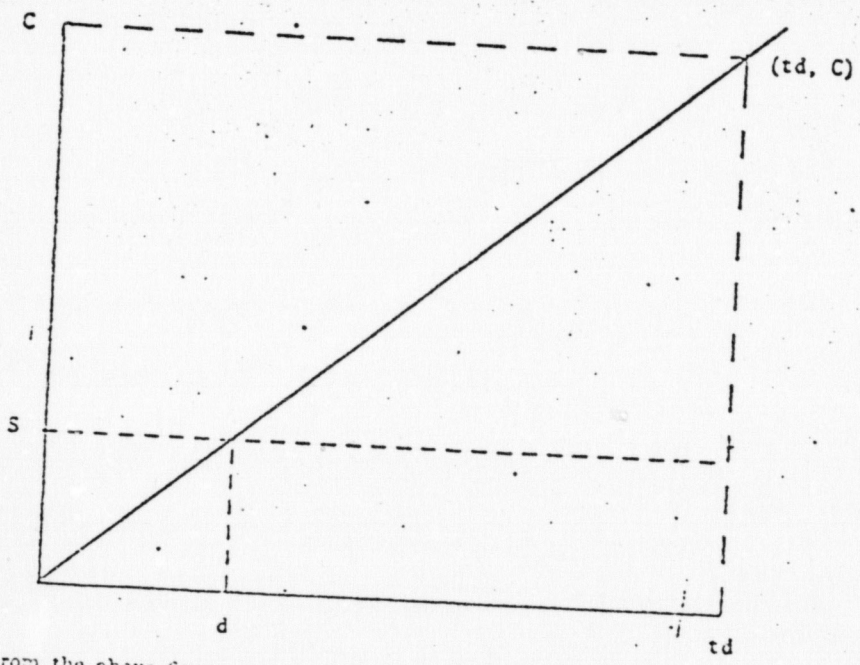
C=Upper confidence limit on the result (computed as shown below).

S=Arbitrary "acceptable" response level.

d=Acceptable risk dose (ARD), that which causes no more than the arbitrarily allowed acceptable risk.

t d=Test dose, some multiple, t, of the tolerated dose.

These values are related as shown:



From the above figure, we have the following relationships: C/S=(t·d)/d=t which can also be stated as C=St.

Since C is a function of the size of the experiment, N, we have a relationship between S, t, and N where N=sample size.

For zero positive responses, the upper a% confidence limit is $S=C=1-e[\ln(1-a)]/N$, where ln is the natural logarithm. From this relationship, given any two of the values N, t, and S, we can solve for the third. The accompanying graphs have this relationship shown for difference values of N. Figure A1 s for a 95% confidence limit: Figure A2 is for a 99% confidence limit.

In any specific situation St is constant (=C), so that we can increase the range of the chart by dividing S (the tolerable risk level) by k while multiplying t (the dose multiplier) by k. Two sets of values for S and t are shown on each graph.

EXAMPLES OF HOW TO USE GRAPHS

Given:

a. That we agree to a socially "acceptable" risk level, say .00001 (1 in 100,000).

b. The expected average dose in man is D, and we wish to determine whether is compatible with the acceptable risk.

c. The maximum pharmacologically tolerated dose in our test species is tD, here, say, t=600. (i.e. this species can survive a dose 600 times larger than the verage dose in man).

rocedure (Using "95%" figure)

a. Find t=600 along the bottom scale of the graph. Notice that it is in parenhesis. This means we must look for our S value in parenthesis, too. (Small rrow at bottom of graph.)

b. Find $S=10(\times 10^{-5})$. (Small arrow at side of graph.)

c. Find where the t=600 vertical line crosses the S=.00001 horizontal line. This s at the diagonal line labeled 500.

This means we must conduct an experiment with 500 animals in each group, ielding 0 positives, at a dose level 600 times the "average" dose in man, in order o have some as nce that the average dose in man is within the acceptable risk evel, where ac ible risk is .00001. [This dose may be far too high, for it has een assumed that man's dose-response curve is the same (except for slope) as

the animal species in which we did the experiment. No "safety" factors have been applied.]

2. Given

To repeat the above experiment using a dose 300 X the expected ARD. S=.0000; and t=300.

Procedure

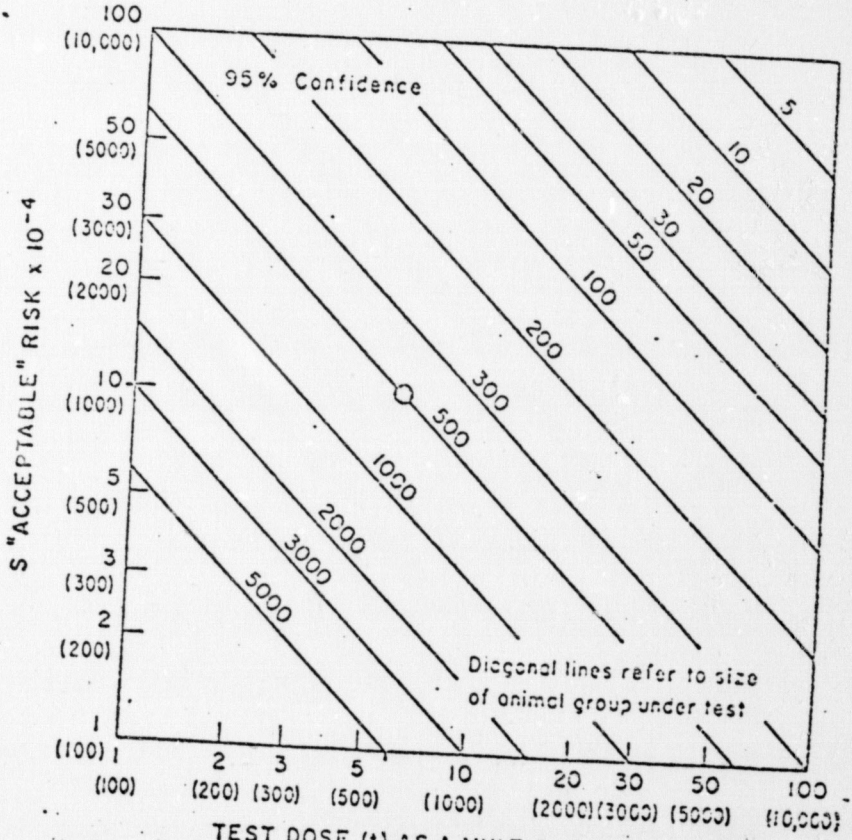
Find t=300 along the bottom scale (in parenthesis).
Find S=10($\times 10^{-4}$)
Note the crossing point at diagonal N=1000.
This means if we test at a lower dose, we must have more test animals to achieve the same ARD.

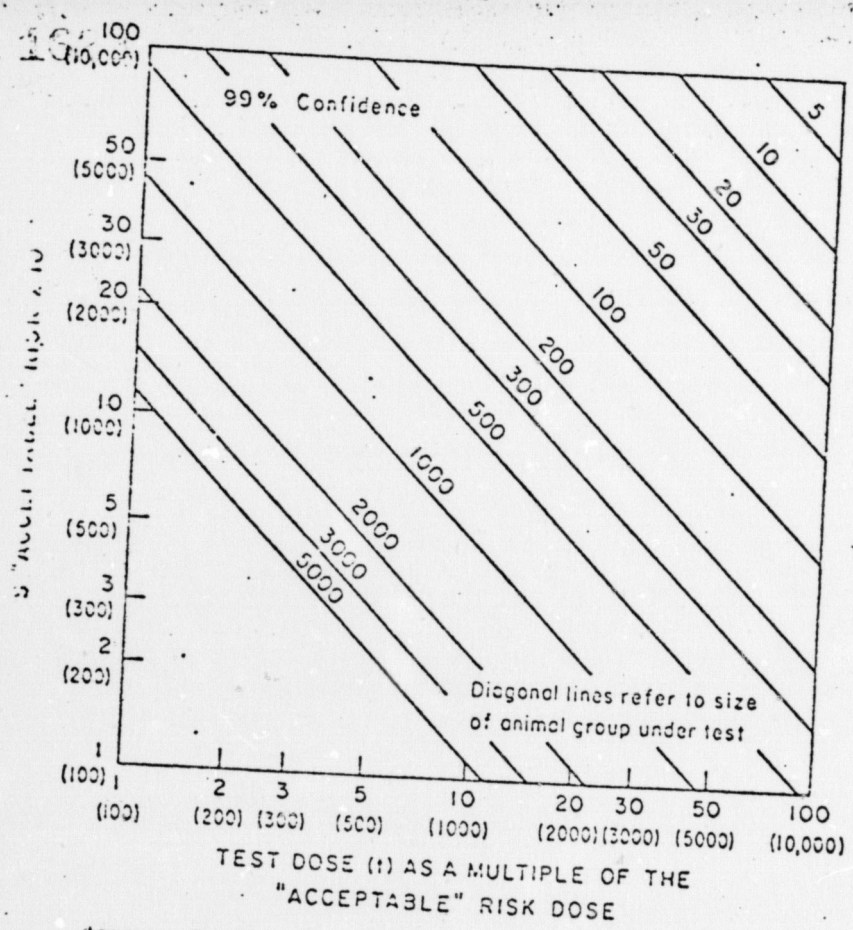
3. Given

To repeat experiment *1* using only 100 animals. N=100; S=10($\times 10^{-4}$)

Procedure

Follow along the horizontal line until you come to diagonal N=100
Look down to the t scale and note that we are at t=3000.
This means if we test with fewer animals, we can have assurance only that a dose 1/t times the test dose will yield less than the acceptable level. Fewer animals in a test imply a lower ARD. In this case the ARD is 1/3000 the test does as compared with 1/600 in Example 1.





Appendix IV—Relationship Between Chemical Analysis, Biological Assays and Carcinogenic Risks to Man

The following set of Figures presents a conceptual scheme for dealing with ...e problems stated. In practice any or all of the steps may be rendered im... ossible by limitations in quantifying pertinent variables. Operational problems ... implementing the plan result from uncertainties in the correspondence of ...man and animal dose response curves, extrapolation of animal data to ex...remely low response levels, differences in response from species to species, ...ynergistic effects, etc. The scheme itself may be useful, however, in defining the ...pecific areas in which further efforts should be made.

Problem No. 1: Given the Presence of a Chemical in the Environment, Estimate Its Carcinogenic Hazard for Man and Determine Its Compatibility With a Socially "Acceptable" Risk

The inputs and the estimations required for this problem are represented in Figure 1 and discussed in the following paragraphs.

1. Analytical Detectability in the Environment—Limited by the sensitivity ...nd specificity of the available analytical method.

2. Quantitative Distribution in Time and Space in the Environment—Prepara... ...ion of "environmental profiles" limited chiefly by extent of sampling. Segments ...of the environment should not be considered non-contributory, because they fall ...elow the mini... ...n levels for analytical detection.

3. Level and Extent of Exposure in Man—Limited primarily by amount information regarding routes and extent of human exposure, and by extent sampling.

4. Biological Detectability of Carcinogenicity—Limited by the sensitivity a specificity of available animal bioassay design.

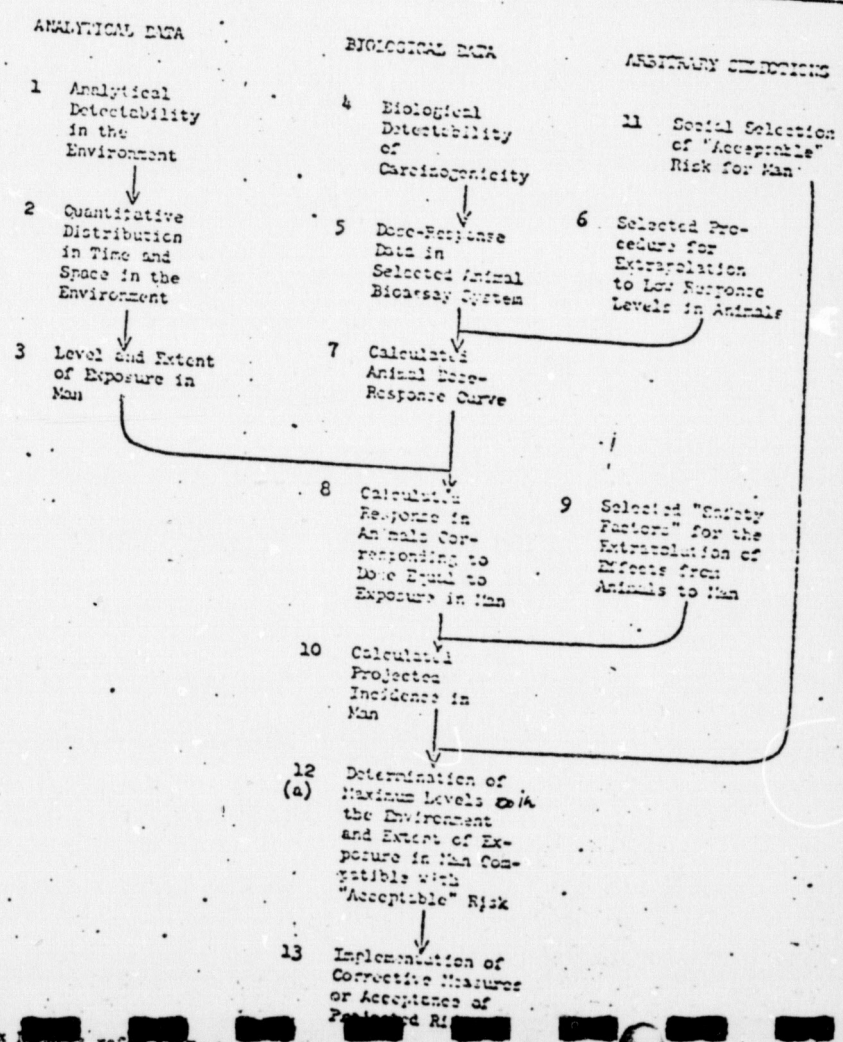
5. Dose-Response Data in the Selected Animal Bioassay System—Limited the sensitivity of the experimental design.

6. Selected Procedure for Extrapolation to Low Response Levels in Animals An arbitrary selection from among a variety of available models made so as avoid underestimating the risk. A proposed methodology for this extrapolati is presented in Appendix III.

7. Calculated Animal Dose-Response Curve—Obtained by calculation fro Items 4, 5, and 6.

PROBLEM NO. 1 - GIVEN THE PRESENCE OF A CHEMICAL IN THE ENVIRONMENT, DETERMINE ITS CARCINOGENIC HAZARD FOR MAN AND DETERMINE ITS COMPATIBILITY WITH A SOCIALLY "ACCEPTABLE" RISK.

INPUTS:



Box Numbers refer to Text

8. Calculated Response in Animals Corresponding to a Dose Equal to Exposure in Man—Obtained by calculation from Items 3 and 7. This provides the basis for the extrapolation from the response in animals to that in man in steps 9 and 10.

9. Selected "Safety Factors" for the Extrapolation of Effects from Animals to Man—This selection is of necessity an arbitrary one, but it must be based on informed judgment. It is severely limited by our lack of specific information on effects in man, and should be made so as to avoid underestimating the risk. The choice of a safety factor of 100, frequently applied in cases of reversible toxicity, is inadequate to cover the complex assessment of carcinogenic risks in man. A factor should be applied for at least each of the following parameters: species susceptibility, interaction and potentiation effects, correction for animal size or body weight.

10. Calculated Projected Incidence in Man—Obtained by calculation from Items 3, 8, and 9, i.e., by taking the level of exposure in man, calculating the tumor incidence that this level of exposure would produce in the animal, and multiplying it by the total selected "safety factor".

11. Social Selection of "Acceptable" Risk for Man—This arbitrary selection is a determining element in the process of decision. It must be based on the most extensive information available on the consequences of accepting a given risk and on the projected "benefits" that would result.

12. (a) Determination of the Maximum Levels in the Environment and Extent of Exposure in Man Compatible with Socially "Acceptable" Risks—Compare Items 10 and 11: if projected incidence in man is greater than acceptable risk, determine what level of exposure in man (Item 3) would give an incidence in man (Item 10) equal to or lower than the acceptable risk (Item 11). Exposure can be reduced by changes in the environmental levels and distribution, or by reducing the number of people exposed.

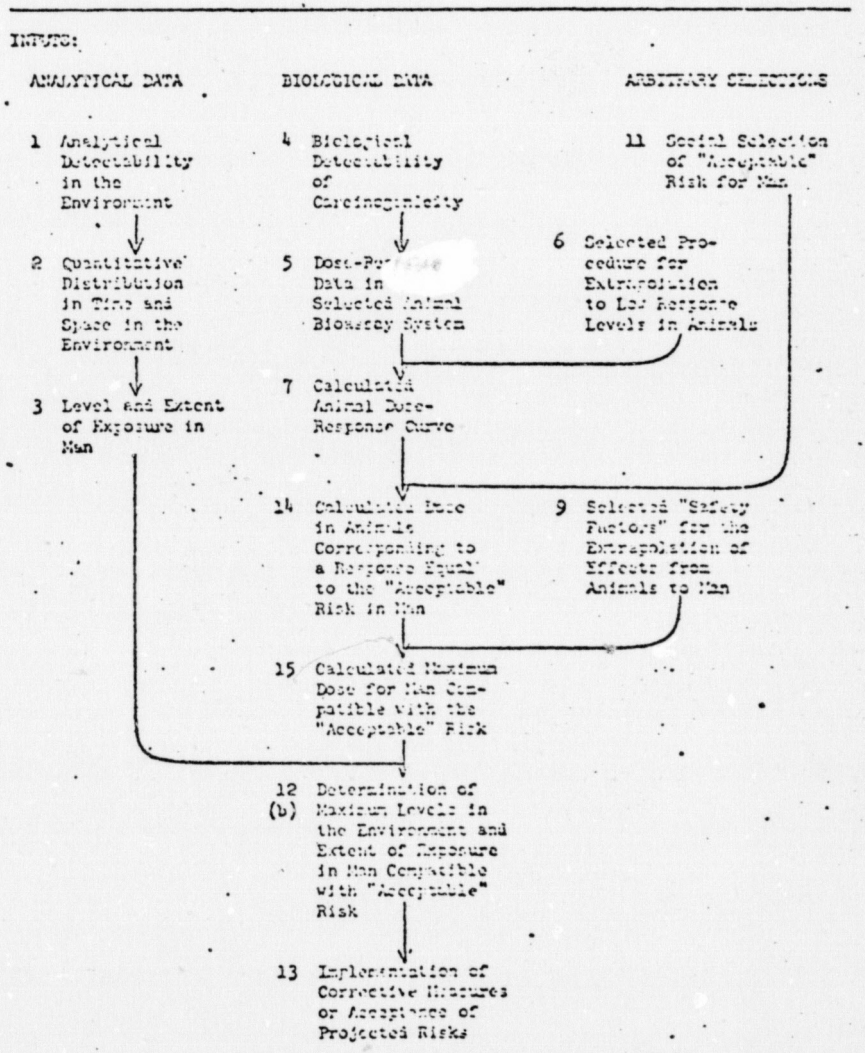
13. Implementation of Corrective Measures, or Acceptance of Projected Risks—Implementation of corrective measures necessary to reduce the projected risk to a socially acceptable level may be extremely difficult. In such cases, the extent of the risk should be clearly stated and a continuing effort developed towards control of the problem.

PROBLEM NO. 2: GIVEN A PROPOSAL TO INTRODUCE A CHEMICAL INTO THE ENVIRONMENT, ESTIMATE THE MAXIMUM EXPOSURE LEVEL FOR MAN COMPATIBLE WITH A SOCIALLY "ACCEPTABLE" RISK

The inputs and estimates required for this problem are represented in Figure 2. The same definitions used for Problem 1 apply. Two different calculations are involved, those in steps 14, 16, and 12(b).

14. Calculated Dose in Animals Corresponding to a Response Equal to the "Acceptable" Risk for Man—Obtained by calculation from items 7 and 11.

PROBLEM NO. 2 - GIVEN A BIOLOGICAL TO ETIOLOGIC A (CRITICAL SITE THE ENVIRONMENT), DETERMINE THE MAXIMUM EXPOSURE LEVEL FOR MAN COMPATIBLE WITH A SOCIALLY "ACCEPTABLE" RISK



Box Numbers refer to Text

Figure II

15. Calculated Maximum Dose for Man Compatible with the "Acceptable" Risk—Obtained by calculation from Items 9, 14, and 11.

12. (b) Determine the Maximum Levels in the Environment and Extent of Exposure in Man Compatible with Socially "Acceptable" Risks—Based on the calculated maximum dose for man compatible with the "acceptable" risk (Item 15), determined: a. what level and extent of exposure in man would result in a risk equal to or lower than the acceptable risk (Item 11); b. what quantative distribution of time and space in the environment (Item 2) would result in the selected level of exposure in man (Item 3).

The logic sequence illustrated for the [redacted] basic problem [redacted] of carcinogenic risks, require these categories of information:

1. Factual information on the sensitivity of analytical methods and on the extent of environmental distribution and of exposure in man (Items 1, 2, and 3).
2. Factual information on the limits of the biological determination of carcinogenicity, represented by the sensitivity of bioassay methods, the significance levels of the results obtained, and the dose-response data (Item 4, 5).
3. Documentation of the criteria and procedures used for the selection of the arbitrary factors used in the evaluation process. These factors include the selection of a socially "acceptable" risk, of a procedure for dose-response extrapolations in the animal model and of "safety factors" for the extrapolation from animal to man (Items 6, 9, 11).

Only in the case of substances for which we have extensive analytical environmental data and extensive bioassay results (probably including a dose-response study of acceptable quality) can we attempt the exercise of estimating the dose corresponding to an "acceptable" risk for man. This can only be done by clearly stating the justification for each of the arbitrary extrapolation factors chosen. The selections will be justified only if they represent an upper limit of risk acceptance, that is, if they assure us that the risk in man is not underestimated.

REFERENCES

(1) Shubik P, Clayson DB, Terracini B: The Quantification of Environmental Carcinogens. UICC Technical Report Series, Volume 4. Geneve, Switzerland, Braillard E, 1970, 33 p.

(2) Report of a WHO Expert Committee: Prevention of cancer. Wld Hlth Org Techn Rep Ser 276:1–53, 1964

(3) Fleming AS: Statement of Arthur S Fleming, Secretary, DHEW. *In* Hearings before a Subcommittee on the Committee on Interstate and Foreign Commerce of the House of Representatives Regarding Color Additives; 86th Congress, 2nd Session. Washington DC, US Govt Print Office, 1960, pp 499–501

(4) Mantel N, Bryan WR: "Safety" testing of carcinogenic agents. J Nat Cancer Inst 27:455–470, 1961

(5) FDA Advisory Committee on Protocol for Safety Evaluation: Panel on Carcinogenesis: Report on cancer testing and the safety evaluation of food additives and pesticides. Toxicol Appl Pharmacol: (in press), 1970

(6) Committee on Causative Factors of Cancer and Committee on Cancer Prevention: Report of symposium on potential cancer hazards from chemical additives and contaminants to foodstuffs. Acta Un Int Cancer 13:179–193, 1957

(7) Fifth Report of the Joint FAO, WHO Expert Committee on Food Additives: Evaluation of carcinogenic hazards of food additives. Wld Hlth Org Techn Rep Ser 220:1–32, 1961

(8) Food Protection Committee, Food and Nutrition Board: Problems in the Evaluation of Carcinogenic Hazard from Use of Food Additives. Washington DC, National Academy of Sciences—National Research Council Publ No 749, 1960, 44 p; Cancer Res 21:429–456, 1961

(9) Berenblum I: Carcinogenicity Testing. UICC Technical Report Series, Volume 2. Geneve, Switzerland, de Bursen G, 1969, 56 p

(10) Technical Panel on Carcinogenesis: Carcinogenicity of pesticides. *In* Report of the Secretary's Commission on Pesticides and Their Relationship to Environmental Health. Washington DC, US Govt Print Office, 1969, pp 459–506

(11) Shubik P, Sice J: Chemical carcinogenesis as a chronic toxicity test: A Review. Cancer Res 16:732–742, 1956

(12) Clayson DB: Chemical Carcinogenesis. Boston, Massachusetts, Little Brown and Company, 1962, 467 p

(13) Hueper WC, Conway WD: Chemical Carcinogenesis and Cancers. Springfield, Illinois, Thomas CC, 1964, 744 p

(14) Weisburger, JH, Weisburger EK: Tests for chemical carcinogens. *In* Methods in Cancer Research, Volume I (Busch H, ed.). New York, New York, Academic Press Inc, 1967, pp 307–387

(15) Arcos JC, Argus MG, Wolf G: Testing procedures. *In* Chemical Induction of Cancer, Volume I (Arcos JC, Argus MG, Wolf G, eds.). New York, New York, Academic Press Inc., 1968, pp 340–463

(16) Wogan GN: Personal communication

(17) Hartwell [redacted]: Survey of Compounds Which Have Been Tested for Car[redacted] Ad[redacted] In[redacted] Pu[redacted] Healt[redacted] Pu[redacted] 149. [redacted] ington[redacted] C. [redacted]

US Govt Print Office, 1951, 583 p; Shubik P, Hartwell, JL: Supplement 1 to the above. Washington DC, US Govt Print Office, 1957, 388 p; Peters J: Supplement 2 to the above. Washington DC, US Govt Print Office, 1969, 655 p.

Dr. SAFFIOTTI. The second report I mentioned is concerned more specifically with the "Carcinogenicity of Pesticides." It is the report of the Technical Panel on Carcinogenesis of the HEW Secretary's Commission on Pesticides and Their Relationship to Environmental Health (ch. 5, pp. 459–506 of the Commission's report), which has been quoted previously in these hearings. It is the report prepared by the experts that the Commission appointed as qualified to evaluate the problem of carcinogenicity. The NCI scientific staff actively participated in the discussions and the extensive review work of that Panel, and I will quote several statements from that Panel's report, which I think summarizes what is involved in this issue.

The Technical Panel on Carcinogenesis has reached the following positions:

1. The presence of carcinogenic substances (of both synthetic and natural origin) in food might be a significant factor in the occurrence of what is commonly referred to as "spontaneous" cancer in man and animals. Thus, an important object in cancer prevention is the elimination, or reduction to a minimum achievable level, of all substances in the diet of man proven to be carcinogenic in either man or animal.

2. Since the effects of carcinogens on target tissues leading to tumor formation appear irreversible, with accumulation of effects over extended periods of exposure, the reduction of exposure to carcinogenic substances to the lowest practicable level may be one of the most effective measures towards cancer prevention.

3. Many different factors may influence dose-response in carcinogenesis in man and animals. Their complexity is such that no assuredly safe level for carcinogens in human food can be determined from experimental findings at the present time.

INTERPRETATION OF THE RESULTS AND VALIDITY OF ANIMAL TESTS

"Interpretation of results of bioassays on a test material includes consideration of the accuracy and significance of the experimental studies, i.e., experimental design, details of information on test materials, dosage, route of administration, metabolism, excretion and retention, controls (positive and negative), experimental animals and methods, survival, description and time of appearance of toxic and pathologic effects, number, type, and individual distribution of tumors.

Extrapolation from animal data to man.—The evaluation of carcinogenic hazards for man is based on a judgment of all available information: on bioassay, on toxicologic, metabolic and pharmacologic studies, on the extent and route of exposure of man, and on epidemiologic studies. Each compound must be evaluated individually on the basis of all data on its use and effects, including whether residues may occur as a result of use of the particular compound, the nature of its betabolites in man, the storage or retention and excretion, etc. The position of this Panel is that the different qualitative and quantitative responses of various animal species, including man, to carcinogens make meaningful extrapolation from "no-effect" levels in dose-response studies in animals to man currently impossible.

In brief summary: (1) Food additives and contaminants should only be permitted if evidence is provided of no carcinogenic effect after adequate long-term bioassays. The minimum requirements for such bioassays should include: Adequate numbers of animals of at least two species and both sexes with adequate positive and negative controls, subjected for their lifetime to the feeding of a suitable dose range of the test material, including doses considerably higher than would be present in food; (2) any substance which is shown conclusively to cause cancers in animals, when tested under these conditions, should be considered potentially carcinogenic for man and therefore not innocuous for human consumption. Tests which yield benign tumors will nevertheless raise the level of suspicion.

Could you explain -- well, could you tell me if all the data that you presented here came from a particular record that was part of the workmen's compensation?

MR. COTTINE: Yes, indeed, and that record will be Exhibit I.

This is a particular summary of that particular case and the actions that were taken to it.

MR. KUCHENBECKER: Thank you.

MR. KLINE: Do you have any information as to whether it would be technically feasible for PVC industry to need and know the detectable level by October of this year?

MR. COTTINE: We have conducted no surveys, Mr. Kline.

We make no representation based on this survey.

We will submit during the course of our post-hearing submission an analysis, what we have incorporated in this hearing, but at this point I can't express any opinion except to say the technological feasibility is certainly the burden which industry must meet with respect to its proof here.

MR. KLINE: Are you opposed to this concept, to the principle that -- in terms of technical feasibility, perhaps stages might be a possibility?

MR. COTTINE: I certainly would like to assess that concrete frame. Certainly that might be an alternative that would be necessary.

divided up among the various Nadar groups of Public Citizens.

As far as the membership listings, they donate money to that group.

So I think, I will check on this, but there may not be a membership list as such.

MR. COTTINE: We can clarify that, yes.

MR. HECHMAN: Whatever you have, a donation list or anything like that will be fine.

Now, with respect to your own expertise, is either of you trained in chemistry or biochemistry or any of the allied sciences?

MS. HRICKO: I have a bachelor's degree, bachelor of science degree in zoology from Connecticut College.

I have worked for the U. S. Public Health Service in Boston investigating accidental injuries and I have a master's in public health from the North Carolina School of Public Health.

MR. HECHMAN: But you are not an epidemiologist or biochemist?

MS. HRICKO: No, but I have had training in epidemiology.

MR. HECHMAN: Has the Health Research Group done any studies of its own relative to the toxiological questions involved here?

MR. COTTINE: No.

We should indicate that we have conducted no technicological survey nor have we done any independent research for epidemiological survey.

We are submitting material which is available, mostly in the open literature which we believe it will be of assistance to the Secretary in finally setting the standards.

Among those are two articles which have appeared on angiosarcoma and one of those appears in JAMA, and the other --

MR. HECHMAN: Do you have any other data or records that you have available to you in Health Research Group, that bears on this problem; that has not been submitted?

MR. COTTINE: The only records that I have that was inadvertantly omitted from this collection here is simply a survey of the OSHA inspections prior to May 10, 1973, that was a Freedom of Information Act request and was the subject of field information memo.

We would be willing to submit for the record those letters, they simply indicate whether a particular site was inspected by OSHA.

MR. HECHMAN: Have you ever been to a polyvinyl chloride resin plant or vinyl chloride monomer plant?

MR. COTTINE: No, I have not.

MS. BRICKO: No.

MR. HECHMAN: Neither one of you?

MS. HRICKO: No.

MR. HECKMAN: Have you had occasion to view the Viola and Maltoni data in detail and analyze the same?

MS. HRICKO: I was at the hearing on February 15th in which the Maltoni data was presented and also the meeting in New York in which the Maltoni data was presented, and indeed the Viola data.

As you have asked the other people, I have not seen slides of the Maltoni data.

MR. HECHMAN: Have you ever had occasion to go into the question of what is technologically feasible in the way of improvements in any of the vinyl chloride or polyvinyl chloride or fabricating plants?

MR. COTTINE: No, we have not conducted any survey.

MR. HECHMAN: You have any expertise in the matters of valves and packing, things of that sort, that apparently leads to leakage that gives the people difficulty?

MR. COTTINE: Whatever voluntary expertise we have gone on in the past, we have not had the opportunity with respect to the standards.

MR. HECHMAN: Did I understand your testimony correctly?

I am not clear as to whether you are testifying in favor of the standard or in opposition to it.

MR. COTTINE: On page 4, it makes it quite clear that

million limitation. That I think is critical.

There is a difference in our proposal.

MR. HECHMAN: Are you in favor of shutting down the polyvinyl chloride industry if your prerequisites cannot be met?

MR. COTTINE: Certainly we are not in favor of closing down the industry. But that really has no bearing on the representations we have made here. That is the Secretary's determination to be made on the basis of the statutory charge. That is that no employee will suffer impairment of his health.

MR. HECHMAN: From your point of view, the question of technological feasibility is not a factor in this case?

MR. COTTINE: Quite clearly it is. There is no question about that.

We don't disagree with the interpretation of the D.C. Circuit that said it was a relevant criteria. It is one, though, that the Secretary will have to make a determination on, with respect to the record that he has, as we have suggested we will submit our analysis to the extent that our expertise permits it.

But technological feasibility is a relevant criteria. Economic feasibility, as we have suggested, is not one that we consider under the D.C. Circuit decision.

MR. HECHMAN: Your position is that it is appropriate for OSHA to consider what is technologically feasible

and adopt standards in accordance therewith.

MR. COTTINE: No question whatsoever. The legislative history is quite clear.

MR. HECHMAN: With respect to some of your generalizations on the cancer question, you discussed cancer in a generalized way, and I believe, if I am not being unfair, advocating considerable amount of pretesting that would have saved situations like this and many others.

What you said actually could apply to almost everything we know of in the world, is that not true?

MS. HRICKO: Generally we advocate the pre-market testing of chemicals that are used, for example, in the industrial workplace.

We aren't here to talk about the toxic substances. Actually, we will get into that aspect, but the pre-market testing of chemicals could prevent many of these diseases, particularly cancer, that we are seeing today in both consumers, members of the public, and workers.

MR. HECHMAN: Is it fair to say that the Health Research Group is in favor of banning or in some way controlling anything that is a cancer type suspect agent?

MR. COTTINE: We are in favor of the appropriate regulation of the carcinogenic agents. As indicated here, we believe that carcinogenicity can be demonstrated in a variety of ways. This is a case of not only epidemiological

PROCEEDINGS

JUDGE MYATT: All right, ladies and gentlemen. These hearings are resumed.

Since we're in a more intimate setting, perhaps we can move a little faster.

Last night I read off a list of names of people who wanted to make a presentation, and apparently some had decided either to leave or not to wait it out. I caution you on this. You're going to find that you're not going to get your input in as an oral presentation.

All of us are bearing up under this as best we can. I suggest that you stick with us. It's for your interest as well as the public's interest.

What I'm going to do is what I indicated last night. I'm going back to those people that we skipped over last night because they did not respond.

Now, is there anyone here from P.C.I. Industries? Because if you don't speak now, we're going to skip over you and that's going to be it.

Is there anyone here from U-Brand Corporation?

All right. We're back to where we concluded last night. Is there anyone here from General Cable? Step up.

GENERAL CABLE CORPORATION

WILLIAM M. NUCKOLS

MR. NUCKOLS: Good morning. My name is William

Nuckols and I am Director of Corporate Planning for General Cable Corporation.

General Cable is one of the nation's largest independent or noncaptive manufacturers of electrical wire and cable. Electrical wire and cable is a product that is critical to the construction, power utility, communications, shipbuilding, and equipment manufacturing industries, among others, and, because of the importance of these industries to the United States' economy, is critical to the entire economy.

General Cable itself employs 8,100 people and has annual sales approaching half a billion dollars.

We are testifying at these hearings today because we believe that the occupational exposure standard proposed by OSHA regarding polyvinyl chloride could have a severe impact on the operations of the wire and cable industry and, thus, on the economy as a whole.

The wire and cable industry depends upon polyvinyl chloride resin or PVC to provide insulation for many of the wire and cable products produced in the U. S. PVC is a material made from the vinyl chloride monomer that is the concern of the proposed OSHA standard. In fact, out of $4.1 billion of wire and cable products sold annually, $1.5 billion, or well over one-third, represent products insulated with PVC. Moreover, because the use of PVC for insulation is concentrated in four types of wire and cable products, the continued

manufacture of certain wire and cable products is dependent upon the availability of PVC.

Roughly two-fifths of the wire and cable industry's consumption of PVC is used for building wire, one-fifth for cordsets, or wire for appliances, one-fifth for communications wire, and one-tenth for power and control cable. This means, for example, that 85 percent of the building wire manufactured in this country is insulated with PVC.

General Cable is somewhat less dependent than the rest of the industry on PVC -- about one-fourth of our sales involve products insulated with PVC. However, about 2,000 of our employees are dependent upon sales of products insulated with PVC.

General Cable cannot be certain whether it will have any difficulty meeting the proposed OSHA standard itself, because questions about the health implications of polyvinyl chloride have arisen too recently for us to have completed any extensive monitoring program. We are extremely concerned, however, about the effect that the proposed standard might have on the producers of PVC and, consequently, on the supply of PVC.

We have been informed by our PVC suppliers that implementation of the standard as proposed will result in a drastic reduction, and perhaps total cutoff, of PVC supplies. Although we have no reason to doubt the good faith of our suppliers, we are not qualified to comment on the accuracy of

these predictions -- that is OSHA's task.

We are qualified, however, to comment on the impact that any reduction in the supply of PVC would have on various critical areas of the economy: the impact would be grave.

We have already noted the heavy reliance of the construction industry on cable insulated with PVC. If such cable were not available, most construction in this country would come to a halt. Moreover, the supply of cables to power and communications utilities, as well as other industries, would be severely impaired.

We do not think that it is necessary to belabor the crucial connection between the ability of the construction, power, and communications industries to meet rising demands and the ability of the rest of the economy to continue to grow.

In the long run, substitute compounds could probably be developed to replace PVC as insulation if it were essential to do so. In the short run, however, substitution is impracticable for two reasons: first, the necessary raw materials are currently not available in the quantities required. Second, the wire and cable industry would have to undertake considerable product and plant redesign. Certainly it would take at least three, and probably five, years to replace the use of PVC in the wire and cable industry.

Thus, unless OSHA determines beyond a reasonable doubt that the proposed standard would not critically affect

other agents to stabilize the compound, and to form a compound we use an insulation, PVC compound as opposed to PVC resin. Now, in some processes that material is frequently extruded into a ribbon and chopped into fine pellets which can then be processed into subsequent extrusion into wire and cable in that plant or in another plant, but the pellets themselves have already been compounded and it's just a reheating process.

MR. KUCKENBECKER: I'd like to direct your attention to page 3, if I might, the second full paragraph. In the first sentence you mention that "substitute compounds could probably be developed to replace PVC as insulation..." Could you cite us some specifics -- specific examples of substitutes?

MR. NUCKOLS: Taking the area of building wire, which is one of the most important, there are two types of building wires on the market, essentially, PVC-insulated and cross-link polyethylene. A long time ago building wire was made of rubber synthetic rubbers or natural rubbers, but that particular process was abandoned some time ago.

In the case of cross-link polyethylene or rubber compounds, you require a curing process, either by radiation or steam curing; whereas, with PVC you do not, so the type of plant required is considerably different for that type of operation.

It is conceivable that other compounds that do not require curing could be developed over time, but I'm not

qualified to comment on the potential availability of those in the short term.

We do know that supplies of plastics generally are very tight and if we had to make a wholesale switch from one to the other, it would be very unlikely that suppliers could deliver the material required.

MR. KUCKENBECKER: Fine.

The last sentence in that paragraph, you state that it would take at least three, probably five years to replace the use of PVC in the wire and cable industry. What do you base that --

MR. NUCKOLS: Well, there are two factors involved: one, the availability of supplies. I would assume that it would take suppliers of substitute compounds a considerable period of time to build the necessary plants to support the volumes required.

In addition, it would require -- after they developed a suitable compound -- a product and plant redesign potentially on our part, so we cannot see how it can be done in a short period of time. It would at least span three years and possibly as much as five before you'd get back to the same levels of production.

MR. KUCKENBECKER: Have any of your employees been exposed -- been examined for any possible vinyl chloride exposure?

closer --

MR. KUCKENBECKER: Along that line, have you instituted any new engineering methods or workpractices to reduce the exposure to vinyl chloride of your workers?

MR. NUCKOLS: It appears now that we are in compliance with the 50 parts per million standard. Our tests for the lesser level are just now coming through. We started testing last month. We have not completed all our tests yet, so we're not in position to change our work standards.

We are in compliance, as far as we know, with the 50 parts per million standard.

MR. KUCKENBECKER: Thank you very much.

MR. KLEIN: I have a few very brief questions for you. Who are your suppliers of your PVC resins?

MR. NUCKOLS: We deal with most all of the national suppliers. I have a list here --

MR. KLEIN: Excuse me. Could you speak up into the mike?

MR. NUCKOLS: We deal with almost all the national suppliers and I have a list of them here which I'll dig up for you.

Union Carbide, Tennoco, B. F. Goodrich, Conoco, Borden, Firestone, and Panasote (phonetic).

MR. KLEIN: Now, on page 2 of your testimony you indicate that your suppliers have indicated that there'll be a

drastic reduction and perhaps a total cutoff of PVC supplies. Do you know which of those suppliers you're referring to?

MR. NUCKOLS: That matter would be in the knowledge of our purchasing people. I don't know that all of them have made that statement, but some of them have contacted them and made that representation. I would have to go back and check the correspondence with them to find out exactly which ones have so responded.

Some of the comments are verbal and some of them are in fact in writing.

MR. KLEIN: I see. But as far as you know the statement that there'll be a drastic reduction or perhaps a total cutoff is an accurate statement as said to the purchasing agents?

MR. NUCKOLS: That is an accurate statement, yes, and I think it's a matter of the record here that many of the plastics companies have testified similarly.

MR. KLEIN: Thank you.

JUDGE HYATT: Anything else, gentlemen?

Anything from the floor? Yes, sir.

MR. COTTINE: Just -- I'm Bert Cobbine, the Health Research Group.

Just following up Mr. Klein's question, would you submit for the record that written material that was supplied to you regarding the unavailability of the PVC resin?

1562	23	Insert "environmental" before "some"
1563	7, 18 & 22	Change "HECHMAN:" to "HECKMAN:"
1563	16	Insert "University of" before "North"
1564	3	Change "for" to "or"
1564	8	Add "in" after "other"
1564	9	Change "--" to "JCN."
1564	10, 22 & 25	Change "HECHMAN:" to "HECKMAN:"
1565	10, 15 & 21	Change "HECHMAN:" to "HECKMAN:"
1566	2	Change "HECHMAN:" to "HECKMAN:"
1566	3	Change "later part of 1,4 parts" to "level below one part"
1567	3	Change "standard by the" to "recommendations of the Standards Advisory"
1567	4	Change "grateful to" to "in agreement with"
1567	5	Change "contention," to "intention,"
1568	1 & 14	Change 'HECHMAN:' to "HECKMAN:"
1568	2	Insert "of detection" after "level"
1568	8	Change "be placed, the --" to "replace the flat absolute limit of one ppm."
1568	15	Change "can" to "can't"
1568	25	Change "on" to "one"
1569	3, 11 & 24	Change "HECHMAN:" to "HECKMAN:"
1569	23	Insert "relevant" after "consider"
1570	4 & 19	Change "HECHMAN:" to "HECKMAN:"
1570	21	Delete "type"
1571	3, 9 & 19	Change "HECHMAN:" to "HECKMAN:"
1571	7	Change "--" to "Delaney Clause, FDA,"

1571	9	Change "causes an" to "clause is an"
1572	1, 11, 14 & 17	Change "HECHMAN:" to "HECKMAN:"
1572	8	Change "65," to "6(B)(5)
1573	3, 12, 22 & 24	Change "HECHMAN." to "HECKMAN:"
1573	9,11&20	Change "huberg" to "Hueper"
1573	11	Insert "chemical" before "carcinogens."
1573	18-19	Delete "too far behind" and insert "before"
1574	3	Change "stocked?" to "stopped?"
1574	5	Change "65" to "6(B)(5)".
1574	12&19	Change "HECHMAN:" to "HECKMAN:"
1574	12	Change "that" to "they"
1575	1&3	Change "HECHMAN:" to "HECKMAN."
1575	13	Insert "Health" before "Research"
1575	14	Change "Work:" to "Workers"
1582	4	Change "about or own testing," to "zero level, our own testing."
1582	9	Change "compliance" to "appliance"
1583	9	Add "to" after "subject"
1583	12	Change "Ining" to "Driving"
1583	16	Change "PVO2" to "PVC"
1584	2	Change "is" to "isn't"
1584	10	Change "deal" to "even"

H R COMPANY
320 Massachusetts Avenue, N. E.
Washington, D. C. 20002

202-546-6660

American Footwear Industries Association
1611 N. Kent Street, Arlington, Va. 22209 • (703) 522-8070

TESTIMONY GIVEN BY NORMAN V. GERMANY, SENIOR VICE PRESIDENT OF AMERICAN FOOTWEAR INDUSTRIES ASSOCIATION AT THE PUBLIC HEARING ON PROPOSED STANDARD FOR OCCUPATIONAL EXPOSURE TO VINYL CHLORIDE HELD AT THE U.S. DEPARTMENT OF LABOR

My name is Norman V. Germany and I am representing the American Footwear Industries Association. The members of this association are responsible for producing over 90% of the footwear that is manufactured in the United States of America. I am Senior Vice President of the association and am responsible for both the management and manufacturing activities.

The American Footwear Industries Association has already submitted its comments in writing concerning the proposed standard for vinyl chloride under Docker OSH-36 published in the Federal Register dated May 19, 1974. In this testimony I wish to provide further information in support of those written views.

Since many footwear material suppliers have submitted comments relating to the compounding of polyvinyl chloride (PVC), our comments this morning will focus upon the nature of fabricating PVC into footwear, and the widespread use of PVC in footwear, and the economic impact on the footwear industry if PVC supplies are halted, curtailed or interrupted.

At the outset, AFIA strenuously urges that the Occupational Health and Safety Administration adopt a vinyl chloride exposure standard such as that recommended by the Society of Plastics Industry (SPI) which industry can comply with. We have been told by our suppliers that it is impossible for them to manufacture PVC at the no detectable level set forth in the proposed regulation. The phased in approach urged by SPI appears to make a good deal of sense to us. It would permit technology to be developed which accommodates vinyl chloride levels of less than 50 parts per million. It also permits lead time in order to construct new facilities and to develop safer manufacturing processes.

As described in our written comments, we believe that as a secondary user, the footwear manufacturer is already operating under conditions with an extremely low level of vinyl chloride present in the working areas. We have obtained three oral reports and one written report to substantiate this point. Additional data is being accumulated as rapidly as possible to determine vinyl chloride monomer, if any, which may be present in the environment during storage of PVC. AFIA believes in the absence of data showing health hazards, secondary fabricators of PVC should be exempted from the requirements set forth in the regulation.

I would like to take the opportunity this afternoon to briefly describe modern footwear manufacturing and the integral role PVC plays

in shoemaking. As leather has steadily descreased in usage, particularly in lower and medium priced footwear, modern synthetic vinyls have widely replaced leather as a suitable material.

The U.S. footwear industry produces approximately 488 million pairs of conventional footwear per year. We have now accumulated statistics from 75 companies which produce 262 million pairs per annum or 53% of the total production. Of this production, 50% of the footwear manufactured have PVC uppers and 40% have PVC soles and heels. (See chart I)

A.F.J.A. PVC SURVEY

FOOTWEAR MANUFACTURING COMPANIES
(chart I)

Number of companies	75
Total annual production (pairs)	261,554,000
Total number of employees	91,631
PVC machinery value	$37,984,000
Footwear with PVC uppers (pairs)	132,044,000
Footwear with PVC soles and heels (pairs)	119,760,000

Polyvinyl chloride is used in all major components of a shoe including the upper, (all the assembled components above the sole) the sole, and the heel. When PVC is used on the bottom of a shoe, it usually

comprises a single unit either molded directly to the bottom area of the upper or produced separately as a unit and attached by cements (See Appendix 1).

Simply put, PVC is a crucial material for the shoe manufacturer. This is particularly true in light of two critical factors - first import competition from abroad and second the unavailability of substitute materials.

The domestic footwear industry presently faces strong pressure from imports. (See Appendix II). It is absolutely crucial that polyvinyl chloride remain available at or near current prices if the domestic footwear industry has any chance to compete with foreign sources. Let us consider the situation where domestic PVC is increased in price because of the increased difficulty in manufacturing while foreign suppliers are able to retain their existing price structure. If such a circumstance increased the price of PVC materials to the U.S. footwear manufacturer by 25%, it would increase the competitive disadvantage between domestic footwear and the equivalent foreign product by as much as 11% at retail. The U.S. shoe manufacturer is already having to do business with up to 20% retail disadvantage from adverse labor costs and this added burden would increase the retail disadvantage up to 31%. The basis for this estimate is described in Appendix III. If PVC was eliminated altogether, the domestic shoe industry would be placed in a virtually impossible competitive position.

The second factor which demands that PVC remain on the market is the unavailability of substitute materials. In our written comments we pointed out that at the present time there is no adequate substitute for PVC. This comment is based on the fact that the industry cannot change its processing methods in a short period of time, and also that alternative materials are not available in sufficient quantities and at an acceptable price that will process in the existing equipment. Manufacturers producing footwear, if they ignored costs, could choose to adopt a polyurethane coated fabric or revert to leather. This would not be possible, however, without abandoning modern processing methods which depend on the material having the thermoplastic characteristics similar to PVC. Further, from a cost point of view, whatever manufacturing process is involved, a manufacturer would be faced with an increase in material cost for his uppers ranging from 70% to 150%.

The figures previously mentioned do not fully describe the true extent of the impact if PVC was not available to the industry. For example, in the modern processing method referred to as flow molding, there have been significant advances in reducing labor intensity in the construction of the upper part of the shoe. (See Appendix IV) This method of manufacture is one area in which domestic footwear manufacturers can compete with foreign produced footwear. Since flow molding produces a component which has the full characteristics of shape, surface texture and embellishments of a normal stitched assembled upper (See Appendix

V) (Submit Exhibit 1), the final shoe has the complete look of the equivalent footwear with its upper stitched in the conventional manner. (Submit Exhibit 2). Production costs by this method can offer reductions over conventional methods by 15% to 70% depending on the complexity of the upper design. 1647

The manufacturer producing footwear where the complete shoe is made of PVC (See Appendix VI) would be in an even more serious position because he would have to shut down his operations if PVC was unavailable.

If the footwear industry shut down the harshest consequences would be felt in small towns and rural areas.

The footwear industry in most instances has factories in these areas. Thus, before a decision is made that could result in the curbing or shutting down of footwear manufacturing operations in America, it is important to consider the high risk factor involved in tampering with the livelihood of thousands of workers. In many instances the economy of myriads of towns throughout the U.S. would suffer. Such an action would result in egregious curtailment in ancillary industries that feed on this important industrial complex.

An immediate effect in closing footwear manufacturing plants would be felt most acutely in areas such as Maine, Massachusetts, Missouri, New Hampshire, New York, Pennsylvania, Tennesses and Wisconsin. In those states there are heavy concentrations of factories producing footwear,

and in many instances this production accounts for a large share of the income of the smaller cities.

In a recent sampling of footwear manufacturers in the above named states (See Appendix VII), we estimated, from population figures obtained from the 1973 Congressional Staff Directory, that 80 percent of the factories were located in smaller towns with population under 20,000. You will note from the Appendix VII that many towns where factories are located have no figures beside them which indicates the population is under 1500.

In Maine there are factories located in 41 towns, 34 or 83% in areas of less than 20,000 persons; Massachusetts with 44 shoe factory towns, 19 or 43% under 20,000; Missouri, 55 towns, 53 or 96% under 20,000; New Hampshire, 24 towns, 19 or 79% under 20,000; New York, 33 towns, 23 or 69% under 20,000; Pennsylvania 70 shoe factory towns with 59 or 84% less than 20,000; Tennessee has 33 factory towns with 30 or 91% under 20,000 and Wisconsin with 27 towns of which 22 or 81% are under 20,000 population.

Many small and medium size cities, particularly in Massachusetts, have sprung up around major multiple shoe factory operations. In smaller towns, the entire local economy often depends on the footwear industry, either primarily or secondarily. For instance, in northern New York, one town of about 10,000 persons has a shoe factory which accounts

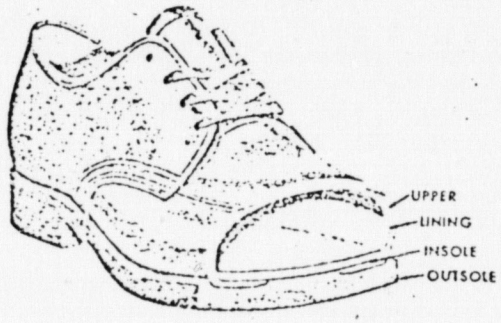
for a $4,000,000 payroll annually thus contributing considerably to employment in the area. It depends largely on its PVC type of operation for producing shoes economically and without this would have to close the plant. In Maine our reports showed that at least 70 per cent of the shoe factories depend on the PVC method to operate effectively and so it follows the same pattern in the other states mentioned above. Further, these states alone produce over 60% of all footwear made in America. (See Appendix VIII).

CONCLUSION

As submitted in our written comments, although the American Footwear Industries Association is not in a position to evaluate the medical evidence relating to vinyl chloride in the atmosphere, it is fully in accord with establishing safe working conditions for employees. However, the final standard which is adopted for vinyl chloride should reflect a PVC concentration level which plastics manufacturers can reasonably comply with. Unless PVC continues to be produced, the American Footwear Industry will be seriously impaired.

APPENDIX I

Injection Molding



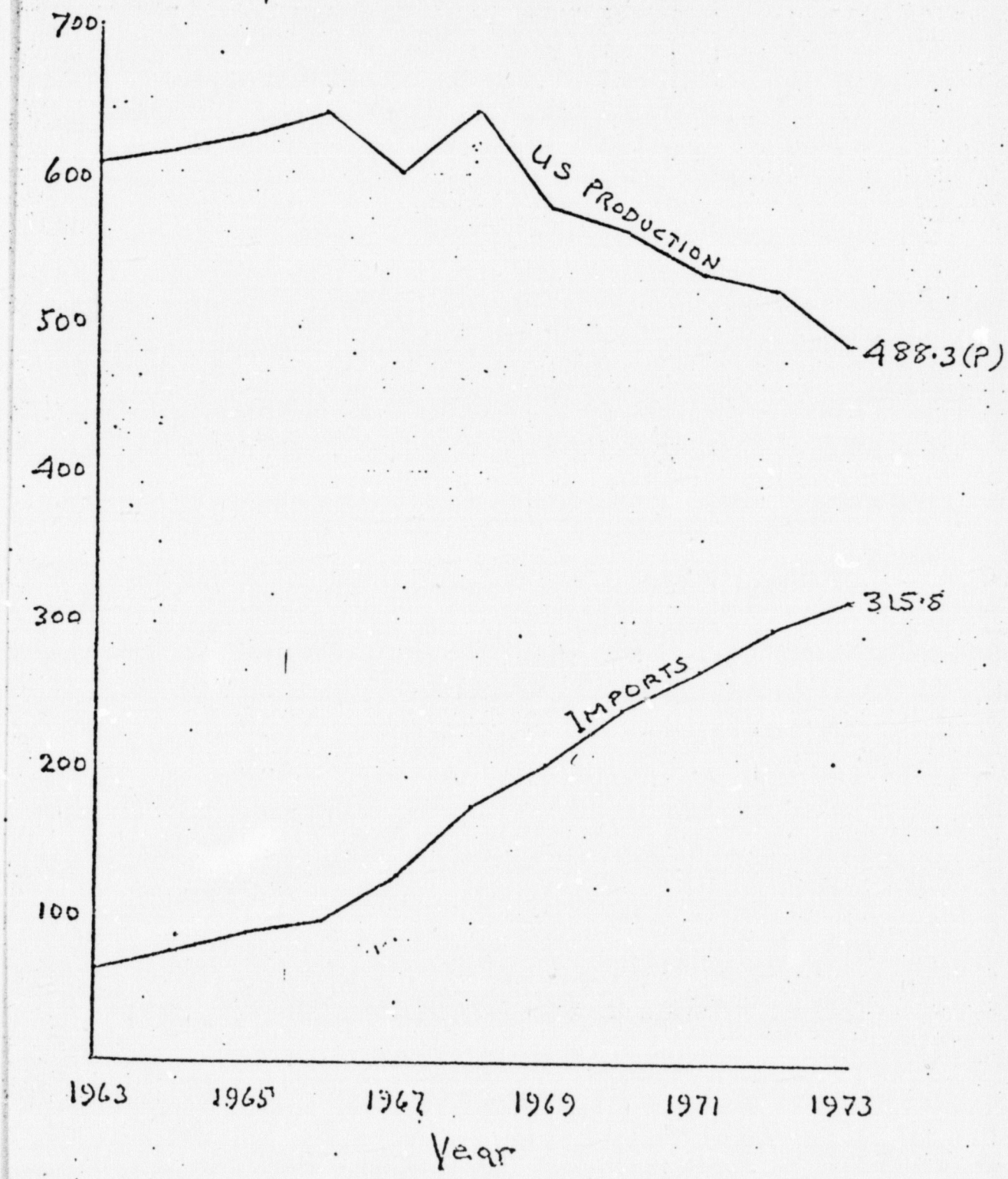
Injection Molding

The injection molding process simultaneously molds and attaches sole and heel units to a pre-assembled upper.

The process lends itself to all types of low heel footwear and is especially suited to casual, service and sports footwear as well as children's, boys' and men's shoes. It is also suitable for many types of dress shoes.

Because of the advancements in synthetic materials and chemistry, and also the versatility of the process itself, injection molding plays a major role in modern footwear manufacturing.

US PRODUCTION & IMPORTED NONRUBBER FOOTWEAR



P - Preliminary figure

SOURCE: Current Industrial Reports of DoC

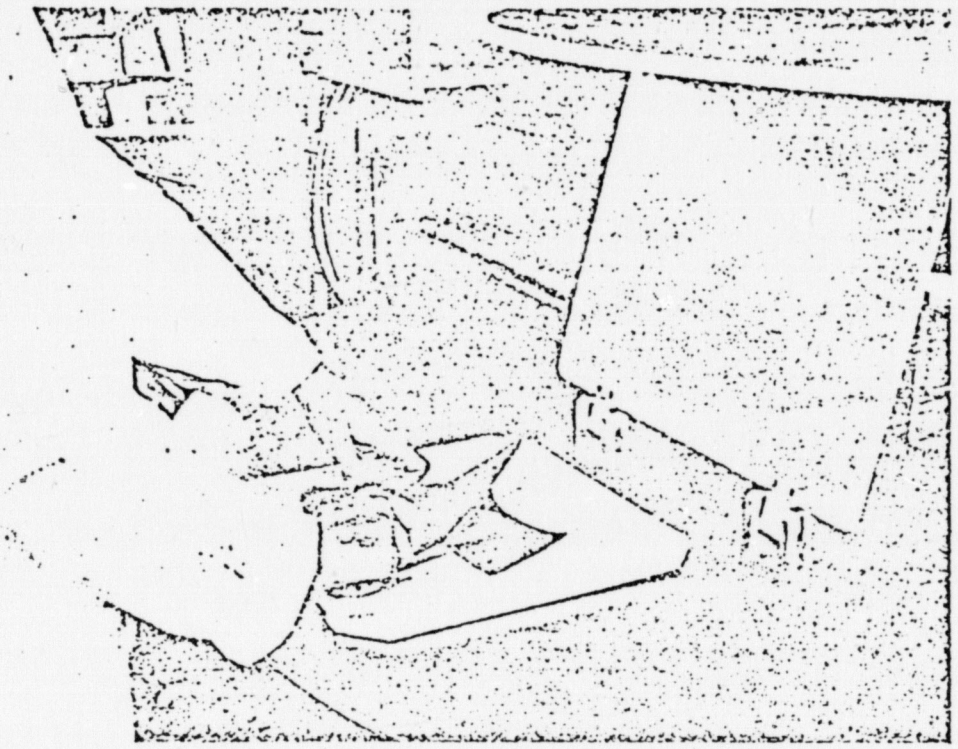
APPENDIX III

POTENTIAL IMPACT OF A 25% PVC PRICE INCREASE
ON DOMESTIC FALL 1974 SHOE PRICES IN VOLUME MARKET

	Children's Shoes	Women's Boot	Men's Shoe
Current PVC Prices	.79	2.35	1.27
PVC Price Increase of 25%	.20	.59	.32
Typical Shoe Manufacturer's Margin	+.04	+.11	+.06
Potential Shoe Manufacturers' Increase Based On PVC Price Increase	.24	.70	.38
Typical Wholesale and Retail Mark-up	+.24	+.70	+.38
Potential Retail Shoe Price Increase Based On PVC Price Increase	.48	1.40	.76
Typical Domestic Wholesale Price Before PVC Price Increase	3.00	7.00	4.50
Estimated Domestic Wholesale Price After Increase	3.24	7.70	4.88
Estimated Wholesale Cost of Import	2.40	5.54	3.46
Typical Domestic Retail Price Before Increase	5.99	13.99	8.99
Estimated Domestic Retail Price After Increase	Between 6.47 & 6.99	Between 15.39 & 15.99	Between 9.75 & 9.99
Estimated Retail Price of Import	Between 4.80 & 5.99	Between 11.08 & 12.99	Between 6.92 & 7.99

Source: Bureau of Statistical Services, AFIA. Estimates based on data from U.S. Department of Commerce - Census and manufacturer records. All estimates are AFIA's.

APPENDIX IV



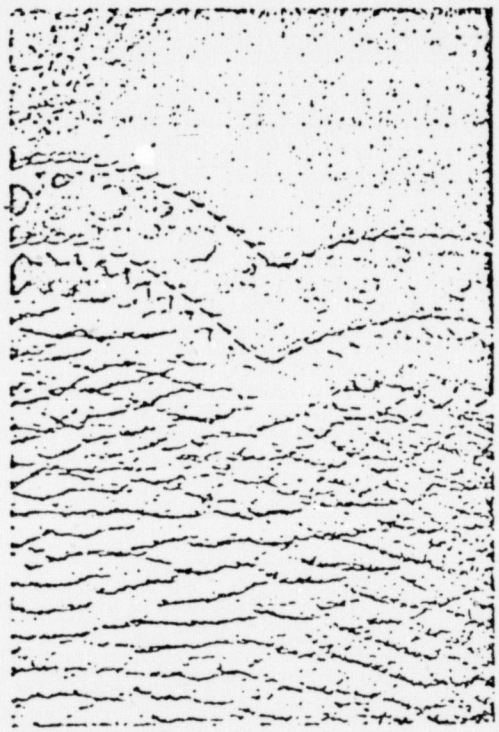
Operator Loading a Flow Molding Machine

d. Flow Molding

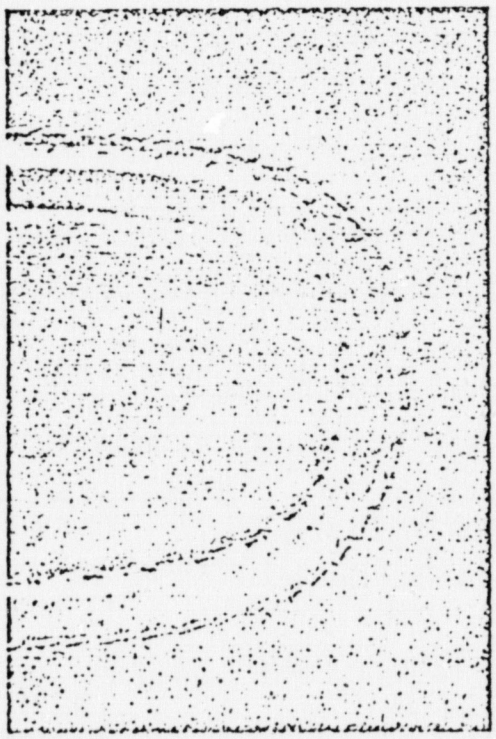
In the flow molding process, the component materials are assembled on a molded impression of the final upper which is resting on the machine table. However simple or intricate the pattern or design that is desired on the finished shoe, all aspects of that pattern are transferred from this mold to the work components.

As the rubber cover is brought down onto the material, electrical heating and pressure are exerted. The material "flows" into and around each marking in the mold due to its thermoplastic susceptibility to the heat. Then, after the cover is removed and the material is again in its solid state, the complete pattern of the finished shoe is imprinted permanently into the material.

Designs, trims and reproduction of various types of constructions are all possible with the flow molding process.



Pinking & Perforating



Pintuck

Examples of
Flow Molding

APPENDIX VI

Complete Molding

Complete molding of an entire shoe may also be accomplished within a mold. Since the whole shoe is constructed in this one operation, no lasting process is required.

Included in this category are:

Slush molding
Injection molding

Slush Molding



Slush molding is a process in which an entire shoe is formed in one operation by means of a hollow mold and heat applications to liquid compounds within that mold. It is useful for certain types of footwear such as protective overshoes and waterproof boots.

Injection Molding

Sometimes the injection molding process is used to produce the entire shoe in a single operation. This method is usually applied to inexpensive shoes and sandals.

APPENDIX VII

1856

LOCATION OF FOOTWEAR MANUFACTURING COMPANIES

STATE	CITY/TOWN	POPULATION	NO. OF COMPANIES
Maine	Auburn	24,000	2
	Augusta	22,000	3
	Bangor	33,200	5
	Belfast	6,000	2
	Biddeford	20,000	2
	Bowdoinham		1
	Brewer	9,000	1
	Bridgton	3,000	1
	Brunswick	16,200	1
	Costigan		1
	Dexter	4,000	1
	Farmington	6,000	1
	Freeport	5,000	2
	Fryeburg	2,000	1
	Gardiner	7,000	2
	Hampden	5,000	1
	Harrison		1
	Kenduskeag		1
	Kennebunk		1
	Lewiston	42,000	12
	Limerick		1
	Lincoln	5,000	1
	Livermore Falls	4,000	1
	Newport	23,000	1
	Norridgewock	2,000	1
	North Jay		1
	Norway	4,000	1
	Old Town	9,000	2
	Phillips		1
	Pittsfield	4,300	2
	Portland	65,000	1
	Presque Isle	12,000	2
	Richmond	2,000	1
	Saco	12,000	1
	Sanford	16,000	2
	Scarborough	8,000	1
	Skowhegan	8,000	2
	South Berwick	3,500	1
	South Portland	23,300	1
	Westbrook	14,500	1
	Wilton	4,000	1

STATE	CITY/TOWN	POPULATION	NO. OF COMPANIES
Massachusetts	Amesbury	11,388	1
	Andover	24,000	1
	Athol	11,200	2
	Boston	641,000	6
	Braintree	36,000	1
	Bridgewater	12,000	2
	Brockton	80,000	7
	Cambridge	100,000	4
	Chicopee	67,000	1
	Danvers	26,200	1
	Dudley	8,000	1
	East Brookfield	1,800	1
	Everett		1
	Fitchburg	43,400	4
	Haverhill	46,120	7
	Hudson	16,000	1
	Lawrence	67,000	6
	Lowell	94,300	6
	Lynn	90,300	12
	Malden	56,157	1
	Marlboro	27,940	2
	Medford	64,400	1
	Middleboro		2
	Milford		2
	Millis	5,686	1
	New Bedford	102,000	2
	Newburyport	15,900	1
	Newton	91,066	1
	Norfolk	5,000	1
	Peabody	48,000	1
	Randolph	27,000	1
	Rockland	16,000	2
	Sagamore		1
	Salem	40,500	3
	Stoughton	23,500	1
	Taunton	43,800	1
	Wakefield	25,400	1
	Ware	8,187	1
	Watertown	39,307	1
	Webster	15,000	3
	Whitman	13,059	1
	Williamsett		1
	Wilmington	17,100	1
	Worcester	176,572	5

STATE	CITY/TOWN	POPULATION	NO. OF COMPANIES
Missouri	Advance		1
	Aurora	6,000	1
	Belle		1
	Bernie	1,641	1
	Birch Tree		1
	Brookfield	5,491	1
	Cabool		1
	Cape Girardeau		1
	Carthage	11,035	1
	Caruthersville	7,350	1
	Cassville	1,910	1
	Chaffee	2,793	1
	Charleston	5,131	1
	Clayton	16,222	1
	DeSoto	5,984	1
	Dixon		1
	Eldon	3,529	1
	El Dorado Springs	3,300	1
	Farmington	6,590	1
	Fredericktown		1
	Fulton	12,148	1
	Hamilton	1,645	1
	Hannibal	18,609	1
	Hazelwood	14,082	1
	Hermann	2,658	1
	Houston	2,178	1
	Jackson	5,896	1
	Jonesburg		1
	Kirksville	15,560	1
	Mansfield		1
	Marionville		1
	Marshall	11,847	1
	Mexico	11,807	1
	Monett	5,937	1
	Mountain Grove	3,377	1
	Neosho	7,517	1
	Owensville	2,416	1
	Palmyra	3,188	1
	Parma		1
	Perryville	5,149	1
	Poplar Bluff	16,653	1
	Potosi	2,761	1
	St. Clair	3,000	1
	St. Louis	622,236	12
	Salem	4,363	1
	Sarcoxie		1
	Sedalia	22,847	1
	Sikeston	14,699	1
	Sullivan	5,100	1
	Tipton	1,914	1
	Union	5,183	3
	Versailles	2,244	1
	West Plains	6,893	1
	Willow Springs	2,045	1
	Windsor		1

STATE	CITY/TOWN	POPULATION	NO. OF COMPANIES
New Hampshire	Berlin	15,256	1
	Deerfield		1
	Derry	11,712	2
	Dover	20,850	3
	Epping	2,356	1
	Exeter	8,892	2
	Farmington	3,588	2
	Franklin	7,292	1
	Gonic		1
	Hudson	10,638	1
	Intervale		1
	Keene	20,467	2
	Laconia	14,888	1
	Lisbon	1,480	1
	Littleton	,290	2
	Manchester	87,754	8
	Nashua	55,820	3
	Newmarket	3,361	2
	Newport	5,899	2
	Portsmouth	25,717	1
	Rochester	17,938	2
	Rollingsford	2,273	1
	Seabrook	3,053	1
	Somersworth	9,026	3

United States -- dead and living -- were observed in

STATE	CITY/TOWN	POPULATION	NO. OF COMPANIES
New York	Amsterdam	25,524	1
	Atlantic Beach	1,640	1
	Auburn	34,599	1
	Batavia	17,338	1
	Binghamton	64,123	2
	Bombay		1
	Bronx		2
	Brooklyn		21
	Buffalo	462,768	2
	Chester	1,627	1
	Dansville	5,436	1
	Dolgeville	2,872	2
	Endicott	16,556	3
	Gloversville	19,677	1
	Hauppauge	13,957	1
	Hopewell Junction	2,055	1
	Jamaica		1
	Johnson City	18,025	1
	Johnstown	10,045	1
	Little Falls	7,629	1
	Long Island City		5
	Malone	8,048	1
	Middletown	22,607	2
	Moira		2
	New Rochelle	75,385	1
	New York City	7,876,760	48
	Norwich	2,098	1
	Plainview, L.I.	32,195	1
	Port Jervis	8,852	1
	Rochester	296,233	4
	Saugerties	4,190	1
	St. Johnsville	2,089	1
	Syracuse	197,208	1
Pennsylvania	Akron	3,150	1
	Allentown	106,000	2
	Altoona	63,000	3
	Arendtsville		1
	Auburn		1
	Beaver Springs		1
	Bedford	3,300	1
	Big Run		1
	Boyertown	4,400	1
	Carlisle	18,079	1
	Columbia	11,237	1
	Coopersburg	2.326	1
	Denver	2,248	1
	Dunmore	17,300	1
	E. Berlin		1
	Elizabethtown	8.072	2
	Elizabethville	1,629	1
	Ephrata	9,662	2
	Exeter	4,670	1
	Fairfield		1
	Forest City	2,322	1
	Gettysburg	7,275	2

Firestone is actively and vigorously evaluating all

1981

STATE	CITY/TOWN	POPULATION	NO. OF COMPANIES
Pennsylvania (Continued)	Graterford		1
	Greencastle	3,300	1
	Halifax		1
	Hanover	15,600	3
	Harrisburg	68,000	1
	Hazelton	30,000	2
	Hunti gdon	7,000	1
	Jersey Shore	5,300	1
	Kutztown	6,000	3
	Lancaster	59,600	2
	Lebanon	28,572	3
	Lititz	7,000	4
	Littlestown	3,000	2
	Macungie		1
	Marietta	3,000	1
	Martinsburg	2,000	1
	Maytown		2
	McSherrystown	3,000	1
	Mechanicsburg	2,000	1
	Mildred		1
	Millersburg	3,000	2
	Milton	8,000	1
	Mont Alto	2,000	1
	Mt. Holly Springs	5,000	1
	Mount Joy	5,000	2
	Mount Union	3,600	1
	Nanticoke	15,000	2
	Newville	1,631	1
	Orwigsburg	2,661	2
	Palmyra	8,000	2
	Peckville		1
	Philadelphia	1,948,609	7
	Pittsburgh	520 000	1
	Portage	4,000	1
	Reading	88,000	3
	Richland		2
	Schuylkill Haven	6,000	2
	Shamokin		3
	Somerset	6,200	1
	Telford	3,400	1
	Tunkhannock	2,250	1
	Tyrone	7,000	1
	Waynesboro	10,000	2
	Wellsville		1
	West Hazelton		2
	Wilkes-Barre	59,000	8
	Williamsport	38,000	1
	Wood		1

STATE	CITY/TOWN	POPULATION	NO. OF COMPANIES
Tennessee	Ashland City	2,027	1
	Byrdstown		1
	Camden	3,052	1
	Carthage	2,491	1
	Centerville	2,592	1
	Chapel Hill		1
	Chattanooga	119,082	1
	Clarksville	31,719	2
	Cookeville	14,270	1
	Cowan	1,772	1
	Dresden	1,939	1
	Dyer	2,501	1
	Franklin	9,404	1
	Gallatin	13,093	1
	Hartsville	2,243	1
	Hohenwald	3,385	1
	Humboldt	10,066	1
	Lebanon	12,492	1
	Lewisburg	7,207	1
	Lexington	4,955	1
	McKenzie	4,872	1
	McMinnville	10,662	1
	Mountain City	1,683	1
	Nashville	447,877	3
	Pulaski		1
	Savannah	5,576	1
	Selmer	3,459	1
	Smithville	2,997	1
	Springfield	10,000	1
	Tullahoma	15,311	1
	Union City	1,925	1
	Waverly	3,794	1
	Waynesboro	1,983	1
Wisconsin	Antigo	9,000	1
	Beaver Dam	14,300	1
	Belgium		2
	Beloit	36,000	1
	Berlin	5,400	2
	Cedar Grove		1
	Chippewa Falls	12,400	3
	Edgerton	4,000	1
	Gillett		1
	Jefferson	5,500	1
	LaCrosse	51,200	1
	Marshfield	15,600	1
	Merrill	9,500	1
	Milwaukee	717,100	7
	New Holstein	3,000	1
	Oconomowoc	9,000	1
	Oconto	5,000	2
	Oshkosh	53,200	1

STATE	CITY/TOWN	POPULATION	NO. OF COMPANIES
Wisconsin (Continued)	Portage		2
	Pulaski	1,700	1
	Rib Lake		1
	Sheboygan	48,500	2
	Sturgeon Bay	6,800	1
	Thiensville	3,200	1
	Valders		1
	Waterloo	2,300	1
	Waupun	8,000	1

APPENDIX VIII

STATES	PAIRS OF SHOES PRODUCED IN 1973
Maine	31,741,000
Massachusetts	48,073,000
Missouri	49,410,000
New Hampshire	25,364,000
New York	50,928,000
Pennsylvania	66,363,000
Tennessee	38,198,000
Wisconsin	14,779,000
total	324,856,000

Total shoes produced in the U. S. in 1973--488,326,000

78 A.

1665

STATEMENT OF POSITION OF T. C. WALKER, PRESIDENT, FIRESTONE PLASTICS COMPANY, A DIVISION OF THE FIRESTONE TIRE & RUBBER COMPANY, WITH RESPECT TO THE PROPOSED PERMANENT STANDARD DEALING WITH OCCUPATIONAL EXPOSURE TO VINYL CHLORIDE

STATEMENT OF TODD C. WALKER, PRESIDENT,

FIRESTONE PLASTICS COMPANY,

POTTSTOWN, PENNSYLVANIA.

JUDGE MYATT:

My name is Todd C. Walker. I am the President of the Firestone Plastics Company, a division of The Firestone Tire and Rubber Company.

We are submitting a 380 page written document concerning all aspects of the OSHA proposed permanent standard relating to vinyl chloride. We respectfully request that our written statement be considered in total by the Secretary in his deliberations concerning the permanent standard for vinyl chloride.

Firestone has two PVC plants.

Our Pottstown plant began producing PVC resin in 1947.

Our Perryville, Maryland plant began producing PVC resin in 1968.

We employ approximately 600 people in our PVC manufacturing facilities, and produce in excess of 400 million pounds per year, thereby making Firestone one of the largest PVC producers in the United States.

In addition, we have three fabricating plants located in Pottstown, Pennsylvania; Salisbury, Maryland; and West Caldwell, New Jersey that employ approximately 250 people. We calendar and fabricate 75 million to 100 million yards per year of PVC film and sheeting. Therefore, we are both a PVC producer and a PVC fabricator.

Firestone's management is gravely concerned about the potential health hazard which may result from indiscriminate exposure to vinyl chloride monomer. Present medical and scientific data, however, do not justify the abrupt termination of an industry affecting literally millions of people which clearly will occur if the proposed permanent standard with respect to vinyl chloride is adopted.

Firestone's position with respect to this matter was reached with profound study and concern about the health aspects which may result from undue exposure to vinyl chloride monomer. As a result of the Company's intensive review and study of the medical problems that potentially exist and the severe impact that adoption of the proposed standard will have on Firestone and the industry, we have concluded that prudent and careful management of all operations involving vinyl chloride are required, and that every technologically feasible method that can be employed to protect the people

involved in the industry must be adopted.

Firestone is committed to expend all the capital necessary for the research, development and implementation of those procedures which will reduce employee exposure to vinyl chloride monomer to the lowest technologically feasible level.

Because the exposure levels of the proposed standard are however technologically unachievable, a reasonable and medically prudent exposure level must be selected with the intent of protecting the health and safety of all engaged in the industry. A reasonably achievable and feasible exposure level, in conjunction with safe and practical work practices rules must be adopted with, of course, the overriding consideration being attainment of the most limited exposures of VCM to industry employees.

Firestone submits that a safe and medically sound -- as well as a technologically and economically feasible -- standard is that which provides for a 25 ppm TWA and 40 ppm ceiling exposure level.

Close and careful adherence to this level with appropriate and adequate work rules will assure safe working conditions without destroying the entire industry. These levels, if properly implemented and enforced, will minimize occupational risks and afford industry and the engineering community opportunities to develop more

sophisticated and advanced techniques which can be employed further to reduce vinyl chloride levels in the ambient air.

The exposure level standard which Firestone proposes, 25 ppm TWA coupled with a 40 ppm ceiling -- is not one which is immediately achievable nor a level which can be accomplished without the expenditure of millions of dollars at Firestone alone.

However, it is technologically achievable and although one which will have measurable economic consequences on the PVC industry, which has not been mentioned in any depth in this hearing, it is a level under which the industry can survive. This exposure level should be maintained as the permanent standard until further ongoing medical experimentation and study -- of the human as well as animal experience -- is completed and more definitive conclusions have been reached concerning the nature and consequences vinyl chloride may have on industry employees.

Firestone does not totally concur with the position advanced by SPI on behalf of many PVC manufacturers, primarily with respect to the adoption of a standard which would require exposure concentration levels to be reduced in succeeding years to a ceiling value of 25 ppm by October, 1975, and to a 25 ppm ceiling and 10 ppm TWA by October of 1976 and thereafter.

The United Kingdom, which is the fourth largest PVC producing country in the world, clearly stated their position through Mr. A. W. Barnes (Chairman, Chemical Industries Association's Vinyl Chloride Committee) in a press conference with the Royal Society of Medicine, London, England on May 16, 1974.

The crux of the United Kingdom situation is that they have been able to reduce their mid 1973 VCM exposure levels of 150 ppm, TWA to current VCM exposure levels of 50 ppm, TWA.

They are committed to expend millions of pounds to further reduce VCM exposure but they are not sure, before the installation of the equipment itself, as to how low they can actually go, and they do not feel they will ever be able to go below 10 ppm, TWA in existing plants, if in fact 10 ppm itself is achievable.

Firestone's engineering studies indicate that it is impossible on the basis of the present state of technology and the engineering art to predict with any degree of certainty that the reduced levels suggested by SPI can be achieved in existing facilities and that continuing animal studies and human epidemiological studies should indicate the necessity of reduced VCM concentration exposures.

Firestone, as covered in great detail in our written statement, has already instituted a medical surveillance program even more stringent than that proposed by NIOSH, which involved expenditures of more than $100,000 per year.

Firestone has already placed a purchase order for a constant sequential monitoring system to be installed as soon as possible in our Pottstown, Penna. and Perryville, Maryland facilities. The cost of this equipment is in excess of $500,000.

Firestone has also committed millions of dollars to minimize VCM exposure levels in our existing operations. However, it is our position that the extent to which exposure levels can be further reduced cannot presently be numerically predicted. Lower exposure levels recommended by others are based on sheer speculation and conjecture. Adoption of such levels will have a substantial effect on the industry while providing questionable additional protection to industry employees.

MEDICAL AND SCIENTIFIC STUDIES

Prior to this hearing the only medical and scientific data which existed was the Tabershaw-Cooper Study. All of the recent reported studies on which the exposure level in the proposed permanent standard was based were done on animals - primarily rats and mice.

However, at this hearing, we heard Dow Chemical present studies of living employees having 15 years or more of monitored VCM exposure and mortality studies of workers exposed to various monitored levels of VCM. The results of these studies showed -clearly- that no abnormalities whatsoever from what was expected were observed in employees exposed up to 200 ppm, TWA.

In addition, Air Products submitted a death certificate study and a review of existing employee medical surveillance

data -indicating only one case of AOL but no other abnormalities from what would be expected- or cases of angiosarcoma.

The Dow and Air Products studies were confirmed by Union Carbide, Diamond Shamrock -and as I will report on- by an in-depth Firestone sponsored mortality study which compared Firestone's experience at its Pottstown Plastics Plant with the experience at its Pottstown tire plant.

Furthermore, no scientific study exists which establishes to what degree, if any, studies of the carcinogenic effects on rats and mice can be extrapolated to humans.

Dr. Marvin Kuschner, Dean of School of Medicine, and Chairman of the Department of Pathology, State University of New York at Stony Brook, indicates in a report which is included in our statement of position submitted to the Secretary today, that there is not only an enormous difficulty in interspecies extrapolation with specific respect to the preliminary animal findings at high levels of exposure -- 2500 ppm -- as reported by Maltoni and Bio-Test but also it is entirely proper to inquire into the possibility that man is considerably less susceptible to angiosarcoma than rodents exposed to VCM. Dr. Kuschner's conclusion with respect to interspecies extrapolation have been confirmed at this hearing by Dr. Key, Dr. Keplinger, Dr. Gehring Dr. Kotin and Dr. McBurney.

Indeed it has been suggested by Maltoni himself at a meeting of the New York Academy of Sciences on May 10 and 11, 1974, that the ages at which the rats which he observed develop the angiosarcoma tumor at 50 ppm were equivalent to a human who developed a tumor 70-80 years after being occupationally exposed to 50 ppm of VCM over a working lifetime.

Indeed Maltoni stated that his rats died "spontaneously" after 150 weeks of life and " did not die of angiosarcoma". It should be noted that the average life span of a rat is 105 weeks.

Consequently, recent reports of Maltoni's findings of angiosarcoma in mice at 50 ppm and Bio-Test's reports of finding angiosarcoma in mice at the same level cannot be evaluated or accepted as conclusive or definitive because the studies involved have not been completed and because of the serious difficulties presented in regard to extrapolating the animal findings in Maltoni's study to the findings of Bio-Test's study.

The fact that human deaths of 16 PVC workers world-wide who were exposed to VCM have been confirmed as attributed to angiosarcoma is cause for considerable concern.

Of great significance, however, is that five of the ten deaths in the United States occurred in employees who had been employed in B. F. Goodrich's Louisville plant.

Moreover, two cases of angiosarcoma were observed in living employees who worked in the Louisville facility.

Thus, seven of 13 cases of angiosarcoma attributed to VCM in the United States -- more than half -- are associated with one plant.

We have been advised that the majority of cases of VCM induced angiosarcoma in PVC workers in the

United States -- dead and living -- were observed in employees who had worked cleaning reactors and were, therefore, exposed to the highest concentrations of VCM in a PVC plant - quite conceivably in the 500 to 1000 ppm TWA range.

Clearly, the human deaths caused by admittedly high levels of VCM exposure not now permitted in Firestone's plants or industry generally, suggest nothing with respect to the effects on humans of the low levels of VCM exposure presently permitted in Firestone's plants and in the industry generally.

That is, on the basis of the existing studies, it is not scientifically or medically known whether continued present low levels of VCM exposure will result in angiosarcoma in a human being, whether or not that human has been exposed to the high concentrations in the past which have now been eliminated.

Further, it may be hypothesized that there would be a substantially higher death rate than has been observed in the industry if historical exposure levels in American industry were substantially dangerous to employees.

To test the hypotheses Firestone has undertaken to study its PVC workforce in order to determine what hazards, if any, have existed in our operations.

Firestone is actively and vigorously evaluating all of its deceased employees who worked at its Pottstown facility since operations began in 1947, including Firestone's tire plant, plastic fabricating and PVC facilities there. It should be noted that these employees were not included in the Tabershaw Cooper epidemiological study commissioned by MCA.

Dr. Michael M. Baden, Deputy Chief Medical Examiner, City of New York and Associate Professor, Department of Forensic Medicine, and Dr. Bernard Pasternack, Department of Environmental Medicine, N.Y.U. School of Medicine, have undertaken at Firestone's request a study of the death certificates of Firestone's Pottstown employees who have died since operations commenced there to determine if the causes of death of any of Firestone's employees in Pottstown, other than the one death already reported, were listed as being caused by or suspected as being caused by angiosarcoma of the liver; and to compare the causes of death of all of Firestone's employees at Pottstown.

In addition to evaluating death certificates, Dr. Baden evaluated, where necessary, hospital records and histological slide materials on Firestone's employees, evaluations which were not undertaken by Tabershaw-Cooper in their study.

1676

The preliminary findings of Dr. Pasternack's proportional study of workers exposed to vinyl chloride during 1947-74 and Dr. Baden's findings and conclusions based thereon have been submitted with our statement of position submitted today.

Findings at the present stage of these studies are summarized as follows:

1. Of the deceased employees who worked in Firestone's PVC facilities and who were exposed to VCM -- 85 of the 87 deaths since 1947 were evaluated -- only the death of the one employee previously reported was caused by angiosarcoma of the liver.

2. There was no significant increase in deaths from any specific malignancy, comparing the employees who worked in Firestone's PVC facilities and were exposed to VCM with those who worked in the tire facilities and were not exposed to VCM.

3. There is no difference in all causes of death among the 32 deceased employees who were exposed to VCM for more than 10 years as compared with the 53 deceased employees who had shorter exposures. Among the 22 malignancies in the group of employees exposed to VCM, there is no difference in type of cancer in those exposed more or less than 10 years -- except for the one angiosarcoma previously identified in the longer exposed group.

This finding, we believe, is of extreme significance.

4. Based on a review of the Tabershaw-Cooper study in addition to other scientific studies, particularly those of Viola and Maltoni and on the review of Firestone's death certificate materials, Dr. Baden concluded: "The issue of threshold still remains to be resolved but there may be a level beneath which exposure to vinyl chloride is not harmful".

Physical examinations and an exhaustive set of liver function tests are also being performed on Firestone's current Pottstown and Perryville PVC employees. Although superhuman efforts have been expended by Firestone's medical department and the Department of Pathology, Northwestern University Memorial Hospital, no results are available for reporting at this hearing on the permanent standard.

Dr. Thomas H. Milby, Adjunct Associate Professor of Occupational Medicine and Environmental Health at the School of Public Health, University of California, has reported that the existing scientific data indicate, at most, VCM is a weak carcinogen rather than a potent one in humans and animals.

On the basis of his investigation, Dr. Milby concluded that it is possible to work with VCM in relative safety at the low exposure levels achievable by the

industry. A copy of Dr. Milby's comments is attached to our written statement.

In addition to the fact that no studies or research have been done to ascertain the effects of present low level VCM exposure on humans, no scientific, medical study, or report has shown that angiosarcoma of the livers of rats and mice is caused by exposures to VCM in concentrations below 50 ppm.

Although it would seem reasonable that threshold values and dose response relationships will eventually be developed with respect to carcinogenesis generally, the particular values and relationships associated with VCM induced angiosarcoma are not now known.

Consequently, it is clear that the state of scientific and medical knowledge available in this area is in its early stages - as has been supported by every medical witness in this hearing to date - and insufficient for the purpose of basing an opinion as to the appropriate occupational exposure to VCM at levels below 50 ppm or even as to the risk of occupational exposure to VCM if the exposure level were established at 50 ppm.

There is not sufficient knowledge to conclude that safe levels of VCM exposure do not exist and it is the opinion of knowledgeable experts like Dr. Kuschner,

1679

Dr. Milby and Dr. Baden, or Doctors Key, Selikoff, Wernehl and others, after review of existing medical and scientific studies, that it is entirely possible that as yet undetermined safe levels of exposure do exist. Speculation of a medical and scientific nature as to a specific appropriate level of VCM occupational exposure between 0 and 50 ppm for humans, based as it must be on inconclusive and uncompleted scientific and medical studies on the effects of low level VCM exposure, is, therefore, without adequate foundation, entirely conjectural, and has no medical relevancy at this time because there are no facts to support any specific number.

Establishment of a " no detectable level" of VCM exposure based on the inconclusive and uncompleted scientific and medical studies on the effects of low level VCM exposure, is, therefore, without adequate foundation, entirely conjectural, and has no medical relevancy at this time because there are no facts to support any specific number.

Establishment of a "no detectable level" of VCM exposure based on the inconclusive and uncompleted scientific and medical studies herein would clearly be arbitrary and capricious, in view of the stated position of the Secretary under the Act with respect to the 14 carcinogens. There, the Secretary rejected the concept

that the carcinogen standard should not allow any exposure.

The same concept guided the Secretary in issuing the standard for occupational exposure to asbestos.

Furthermore, health and safety standards for occupational exposure to radioactive materials, recognized as harmful carcinogens, under the Atomic Energy Act, have not been set at "no detectable levels". Instead, the standards have set limits for exposure above detectable levels, coupled with specified time periods for such exposure. (10 CFR Sec. 20.1, et seq. (1973))

To affirm a no-detectable level for VCM exposure in these proceedings would be entirely lacking in reason and consistency of administrative regulation in view of the more serious health hazards associated with radioactive materials, asbestos and the 14 carcinogens -- as shown by higher incidence of human death connected therewith -- where non-detectable levels were not established, and were, moreover, rejected.

Under these circumstances, a determination by the Secretary establishing a no-detectable level for VCM exposure would be arbitrary and capricious, and certainly lacking in substantial evidence.

The world-wide production of PVC resin has been estimated to be in excess of 16 billion pounds per year with only 25% of the total being manufactured in the United States.

While Firestone does not maintain any interests in any PVC producing facilities in foreign companies - a number of domestic producers do have such interests. It has been estimated, for example, that the B. F. Goodrich Co. has interests of 100%, or less, in foreign operations with a combined annual PVC production of 783 million pounds.

I have already summarized excerpts from a statement of the position being taken by the industry as a whole within the United Kingdom, which is the world's fourth largest PVC producer.

With the curtailment of the domestic PVC industry, foreign producers - unfettered by overly restrictive standards which may be required within the United States - may ultimately take over our domestic market. The impact of this situation will be felt not only by domestic PVC producers - but ultimately by domestic PVC fabricators.

THE PROPOSED PERMANENT STANDARD IS NOT TECHNOLOGICALLY FEASIBLE NOR ATTAINABLE IN THE POLYVINYL CHLORIDE INDUSTRY.

In order to determine whether the proposed permanent standard is technologically attainable, Firestone instituted special technological and engineering studies designed to determine whether the present polyvinyl chloride plants of the Company located in Pottstown and Perryville could be modified and upgraded through process and equipment changes to meet the non-detectable VCM air exposure levels required by the standard.

In carrying out these studies, Firestone obtained the services of an independent engineering consultant, Catalytic, Incorporated, to provide capital cost estimates of the specified modifications to the Pottstown and Perryville facilities in attempting to meet employee exposure levels as required by the standard.

In addition, the Company engaged the services of a professional engineering consultant, Dr. Frederick B. Higgins, Jr., an Associate Professor of Environmental Engineering Technology and Chairman of the Departments of Environmental Engineering and Civil Engineering Construction Technologies at Temple University, to conduct a study and to determine whether a new polyvinyl chloride plant employing the most advanced and sophisticated engineering techniques and equipment could be designed

and constructed to achieve a non-detectable level of exposure as required by the proposed permanent standard.

The clear conclusion resulting from the studies carried out by the Firestone engineering staff in conjunction with Catalytic, Inc., and Dr. Frederick Higgins, Jr. is that Firestone would have no alternative but to cease all polyvinyl chloride manufacturing operations if the proposed standard is adopted. The studies by the engineering and production staffs at Firestone's Pottstown and Perryville plants indicate that despite enormous equipment, engineering and process changes at both of Firestone's existing facilities, costing in excess of $50 million, it is not possible to achieve the drastic non-detectable exposure levels required by the proposed standard based on engineering controls and process modifications.

Dr. Higgins' study and report, a copy of which is included in the Appendix to Firestone's statement of position, confirms the conclusions reached independently by Firestone's engineering staffs. After analyzing the problems encountered in attempting to design and construct a new plant to meet a non-detectable level standard, Dr. Higgins concludes that it is not possible to predict -- even if such a plant were designed and constructed -- that it would be capable of operating at the non-detectable level.

Attempting to provide engineering controls in the PVC industry to reach the "no detectable levels" in even a new plant would require pushing to the limits of available technology and would require an enormous investment of capital. As stated by Dr. Higgins, many of the anticipated problems can be overcome only through use of specially designed equipment and newly created engineering processes.

The conclusions reached with respect to a new plant focus upon and highlight the technological obstacles with which the PVC industry will be confronted in attempting to meet the exposure levels of the proposed permanent standard. Certainly, if technology and engineering is inadequate today to provide an economical and technolotically feasible new plant, it is obvious that existing PVC plants, many of which are in excess of 20 years, cannot be modified and upgraded merely through "engineering controls" to achieve a non-detectable exposure level.

With respect to Firestone's existing Pottstown plant, Dr. Higgins reported that the physical restrictions and the heavy investment in major equipment would limit the application of many control techniques. "Substantial improvement in air quality may be attainable through careful engineering and construction, but the terms of

the proposed regulation as written cannot be met technically in an existing plant".

Dr. Higgins suggests that unless a higher permissible exposure level concentration is adopted, all plant employees would be required to wear air-supplied air masks and protective clothing during a reconstruction program of several years.

The Firestone studies, confirmed by an economic review carried out by Catalytic, Inc. the detail of which is contained in the appendix of our written statement - indicate that between 50 and 55 million dollars would have to be expended by Firestone alone in attempting to achieve the non-detectable level standard. Thus, even disregarding the effects the severe work practice rules will have on production, Firestone would be compelled to make an election between closing its plants or doubling its capital investment in its PVC plants in order to attempt to continue operating.

Under these circumstances, and especially when the magnitude of lost production and additional operating costs are considered, it is obvious that management could not rationally conclude that the additional expenditures were prudent or economically feasible. Because essentially the same technological and economic

1686

problems confront other PVC manufacturers, it is apparent that the management of all concerns will be compelled to reach the same conclusion.

The Act requires the Secretary to adopt feasible standards which have been understood by the courts as well as the Secretary to encompass "technologically achievable" conditions. In proposing the standard with respect to vinyl chloride, the Secretary has not taken into consideration the overwhelming engineering and technological data which decisively establishes that the proposed exposure levels are not attainable through engineering controls and work practice methods. The standard is simply incapable of being implemented by such means. Rather, the effect of the proposed standard will result in the very consequences Congress intended to avoid -- putting employers out of business.

Even though a majority of the PVC industry is capable of operating under the temporary emergency standard, with the use of air-supplied respiratory equipment - the industry in our opinion will not generally be able to function under exposure levels below 50 ppm without making extensive and costly expenditures for new equipment and engineering changes over an extended period of time.

1637

As stated earlier, there has been essentially no mention of the massive capital requirements to achieve - on a permanent basis through the installation of engineering controls - a ceiling value less than 50 ppm in all areas.

Admittedly, Firestone, and we believe the industry as a whole, has been able to, on a short-term basis, with reasonable outlays of capital, reduce vinyl chloride concentration ceiling levels in many areas of the operations to less than 50 ppm - and to utilize air-supplied respiratory equipment in other areas to comply with the Temporary Emergency Standard.

However, we are assuming that the Permanent Standard - when promulgated - regardless of the vinyl chloride exposure level selected - will include the necessity of permanent engineering control in all areas and will only allow the use of respiratory equipment on an interim basis.

It is our contention - and I believe the engineering modifications and capital costs estimates attached as an appendix to our written statement submitted today will confirm - that the continual step-down of ceiling values of vinyl chloride exposure - on a permanent basis - will include tremendously increasing capital outlays - and we believe with questionable values as it relates,

to the well being of our employees. We believe that OSHA - and NIOSH - are improperly interpreting the vinyl chloride exposure level in many operations as they exist today.

I can speak for the Firestone operations in particular.

A team of NIOSH representatives spent several days at our Pottstown facilities in what we heard described earlier as a "walk-thru" survey.

OSHA representatives spent several days each in our Pottstown and Perryville plants just recently. These men, while I'm sure qualified academically - are not intimately familiar with PVC polymerization operations - and I feel can be totally misinterpreting the state of the industry today - and the massive engineering changes and capital required to achieve in the future drastically stepped down vinyl chloride ceiling exposure levels in absolutely all areas within the plants on a permanent basis.

While we are awaiting delivery of our constant sequential monitoring equipment, we are monitoring our employees - and work areas - by the use of air bags - and gas chromatography. We have, for example, in our Pottstown plant a number of areas which are clearly

1699

defined and posted as requiring air-supplied respiratory equipment which we know will require substantial capital outlays to eliminate on a permanent basis.

However, the OSHA representatives - via the use of a hydrocarbon measuring - not vinyl chloride measuring - Century Meter - recorded, I believe in a half dozen readings, a maximum vinyl chloride exposure level in our Pottstown operation of 17 ppm.

If the permanent standard was in fact going to be established both in intent and measured compliance on this basis - Firestone could take a different position in this hearing.

However, Firestone would not interpret or comply with the vinyl chloride permanent standard - or any other standard established to safeguard its employees - except to the intent of that standard - not merely to the letter of law of the standard.

Therefore, while we may stand alone in the position we are taking at this hearing - we are providing - as the Department of Labor requested - a written report substantiating our position from all regards.

Firestone instituted technological studies in concert with Catalytic, Incorporated and Dr. Higgins to determine

the equipment and design changes and plant modifications which might be required in order to achieve on a permanent basis exposure levels below the 50 parts per million specified in the temporary standard.

Additional studies were developed to estimate the feasibility and capital costs of achieving (a) 25 ppm TWA with a 40 ppm ceiling, (b) a 10 ppm TWA with a 15 ppm ceiling, and (c) the non-detectable level required by the proposed permanent standard.

These estimated costs for capital improvements and engineering changes at Firestone's plants were determined on the basis that full compliance with and implementation of the engineering controls and work practice methods specified in the proposed permanent standard will be required regardless of the exposure level ultimately selected.

In carrying out these studies our engineering staff were forced to include certain highly capital intensive engineering modifications -- such as the decontamination or incineration -- of all exhaust gases to insure that we could, in fact, meet the various levels being studied. It is possible that we may be able to achieve lower levels than 50 ppm without implementing some of the costly incineration systems.

There is no question, however, but that total incineration of exhaust gases would be demanded in an attempt to obtain a non-detectable level.

We are not able to determine at this point in time when - between a 50 ppm vinyl chloride ceiling level and a non-detectable vinyl chloride ceiling level - some of the more costly incineration system will be required.

Our written statement being submitted to the Secretary contains extensive engineering data and capital estimates, which could be required to meet the various levels we have studied.

We estimate, with Catalytic, Incorporated confirmation, that as much as $10 million will be required to insure that our operations are not exceeding the 50 ppm standard in any area through engineering means alone. Of course, as I have just indicated, these figures take into consideration full compliance with the intent and the letter of the law of the proposed permanent standard and include a substantial amount for incineration costs.

The engineering studies and capital estimates carried out with respect to Firestone's plants should

be reasonably applicable to other PVC plants of the same general age - 6 years and 27 years - currently in operation in similar geographic areas. Those companies having so called "open-air" plants located in the Southern or far Western regions may have substantial competitive advantages depending upon the vinyl chloride exposure levels contained in the permanent standard.

To be enabled to meet the 25 ppm TWA and 40 ppm ceiling, on the same absolute basis as just stated, as much as $20 million could in fact be required. Despite the potential capital costs involved in achieving these levels, we are in fact recommending this level as the permanent standard. Attempting to achieve a non-detectable level includes estimated capital outlays -- if at all possible -- of $50 million to $55 million. This type of cost would double our existing capital investment.

Dr. Higgins concluded with respect to the possibility of meeting a 10 ppm TWA level:

"A level of 10 ppm on a time-weighted average basis might ultimately be achievable in existing polyvinyl chloride plants through construction of extensive and costly new ventilating collecting and exhausting systems, particularly in high concentration areas, and through revised handling methods in transfer areas. However,

on the basis of present technology, no definite forecasts can be made as to whether this low level can be attained. Whether such a low level is practical and achievable can be determined only after the new equipment and engineering procedures have been installed."

Firestone has greatly accelerated its efforts to provide engineering and technological improvements designed to assure the health and safety of all employees engaged in vinyl chloride operations. Firestone will continue its efforts to achieve further profound reductions in exposure levels to the end that all who work with vinyl chloride can be confident that no health hazard exists by virtue of their employment.

It is our position that the industry should be permitted to continue their efforts to achieve meaningful and realistic health goals without being confronted by an unrealistic and technologically unachievable standard.

4 of 5

1691

STATEMENT OF POSITION OF F. F. HOY, PLANT MANAGER,
FIRESTONE PLASTICS COMPANY, PERRYVILLE, MARYLAND

STATEMENT OF FRANCIS F. HOY, PLANT MANAGER
FIRESTONE PLASTICS COMPANY,
PERRYVILLE, MARYLAND

JUDGE MYATT:

I am Francis Hoy, manager of Firestone's Perryville, Maryland PVC amnufacturing plant. I have been with Firestone for twenty-two years, at least seventeen of it associated with PVC. I have a degree in chemical engineering which I obtained about eleven years ago. My mission today is to discuss our objection to some of the work practices contained in the proposed permanent standard.

WORK PRACTICES

The proposed permanent standard regulating employee exposure to VCM, in addition to requiring technological and engineering changes in PVC plants, contains numerous sections regulating work practices. As with the engineering and technological change provisions, Firestone submits that some of the proposed work rules are not feasible, or in those instances where they are, some may jeopardize employee safety, are counter-productive or add unnecessary costs to production.

In Firestone's statement of position submitted today, we have provided a detailed analysis of the proposed permanent standard showing the hazardous and counterproductive effects of those work rules. We have also provided a proposed permanent standard of our own.

Briefly, now, however, I would like to summarize some of the major points made in our written submittal.

First of all, the proposed permanent standard requires that all of the work practice provisions, as well as the exposure level and engineering change provisions, apply to any area where detectable levels of VCM are released. In view of the fact that VCM producers, PVC manufacturers, plastic fabricators, and users do not share the same VCM exposures, hazards, problems, or abilities to deal with the chemical, the proposed standard should be limited at this time to the VCM producers and the PVC manufacturers, leaving for another time when medical and scientific data are more conclusive and technology more feasible a new standard for fabricators and users.

The proposed "regulated area" language extends coverage

1697

of the standard virtually everywhere, even to restrooms, and clearly beyond areas of occupational exposure to VCM.

The risk of exposure in areas where PVC is repackaged, stored or used is very small, if not virtually non-existent.

To understand why this is so, it will be helpful to review why PVC resin may contain detectable amounts of residual VCM. It is very difficult to strip all the VCM from PVC resin. VCM migrates from PVC resin very slowly. Therefore, residual VCM is detectable at low levels in the resin for considerable periods of time after the resin is made.

If the PVC resin is confined in a closed container, a small amount of residual VCM will slowly migrate from the resin, and if the air space in the container is small, a VCM concentration may be created inside the container. Once the container is opened, the VCM would be difficult to detect because it escapes quickly into the atmosphere.

Nevertheless, measurable amounts of VCM may be retained in the resin and a probe inserted in the container could detect measurable levels.

Consequently, by strict interpretation, all areas where PVC resin is handled could fall under the standard, while in reality employee exposure to residual VCM in the resin in many of these areas would be virtually non-existent.

The effect of a stringent application of this rule would be to unnecessarily broaden the area of control and make a nightmare of implementation. Carried to extremes by an overzealous individual, control could be extended to cover the

truck that hauls the resin, the terminal where it is parked, the customer's lab where a sample container could be opened, or the office of a purchasing agent where a sample might be inspected.

A modification has been suggested which would eliminate these problems without compromising the protection of personnel and which should be considered for inclusion in the permanent standard.

This provision would be one that would exempt areas from regulation where a resin used or handled contains a residual VCM concentration below 0.1 percent. Our concern should be with VCM at the employee breathing level where it may be inhaled and not with the concentration levels that may occur inside a closed container where there is no employee exposure.

The approach of exempting particular areas from regulation where the concentration of the regulated substance is below a certain level has been previously adopted by the Secretary in other carcinogen standards. (29 CFR 1910.93 (c)-(p), 39 Fed. Reg. 3756 (1974))

The Secretary excluded from regulation any solid or liquid mixture containing less than one percent by weight or volume of eight of the carcinogens and for the remaining six excluded any solid or liquid mixtures containing less than 0.1 percent. In so doing, the Secretary stated:

"The overall purpose of the exclusions is to avoid substantial obstruction, if not stoppage, of the use of many processes and products which are considered useful in industry."

An exposure exemption based on these reasons for the 14 carcinogens previously covered is equally, if not more, applicable to VCM, which is considered a less potent carcinogen than those previously identified.

The standard covers the use of respirators. Because the entire PVC plant complex is periodically or continually exposed to detectable levels of VCM, the proposed standard, in effect, requires that respiratory protection be provided for and used by every employee in the entire complex.

The four types of respirators specified in the proposed standard all require the utilization of a full face piece providing for a positive pressure or operating in a pressure demand mode. Such masks are extremely uncomfortable and burdensome and as stated by Mr. Hyatt: "at best an instrument of torture." He clearly spelled how such devices can induce fatigue, impair efficiency and, in many cases, create other occupational hazards in attempting to resolve one hazard. Actually, the wearing of such masks would constitute a safety hazard in and of itself. Operators and maintenance personnel wearing full face masks and carrying an air bottle or trailing air hose cannot provide the alert surveillance needed to avoid accidents. Faulty maintenance is almost certain to occur because the craftsman cannot see clearly or is so preoccupied with the mask as to lose concentration on the job.

Operators must be able to read clearly the instruments describing the state of the reaction in the reacting vessels. They must be alert for upset or dangerous conditions shown.

1780

They must concentrate on the job at hand. Placing employees in a full face piece, air-supplied respirator will diminish their alertness and concentration resulting in poor work and frequent mistakes.

In the course of performing the requirements of various jobs in the plant, employees must move rather extensively around the equipment, between floors, up and down stairs and distances of 30 to 50 feet and more from a central station. Such requirements for mobility make permanent air stations and hoses totally impractical for most jobs. An allowed alternative is a portable back pack air supply unit.

One model weighs approximately 28 pounds and provides an air supply of about 30 minutes. Assuming an adequate safety factor of 10 minutes, an employee would have to change three times per hour or perhaps use units with larger air supplies weighing up to 50 or 60 pounds.

Moreover, changing of tanks would also impede mobility because in changing tanks the employee would have to be in an area containing undetectable levels of VCM. This would require an employee to leave his work area unattended, a safety hazard in itself, in order to effect a tank change.

Tank change areas would have to be specially built and be securely isolated from the work area in order to guarantee noncontamination. Due to these various factors and inconveniences, Firestone's operating personnel have estimated that probably 25 percent of the present employee staff may either terminate employment or request transfers to different areas

if required to wear such respirators during a major portion of their working day.

Firestone submits that the use of air supplied respirators are only necessary when concentrations of VCM reach excessively high levels and that when such incidents do occur, full-face masks are not necessary and are in fact dangerous to employee safety for the reasons given. Respirators which are less cumbersome and provide the employee a greater degree of visibility, mobility and comfort, such as canister type respirators, should be substituted.

The proposed permanent standard requires that employees entering a regulated area shall wear protective full-body clothing, footwear and gloves. Protective clothing is defined to be clothing protective against VCM. To be "protective against VCM", such clothing would have to be impervious to air due to the fact that VCM is a gas.

As a consequence, such clothing would also be impervious to body moisture, resistant to heat passage, and would tend to be extremely abrasive to the skin. In effect, therefore, although the proposed permanent standard attempts to make a distinction between "protective" and "impervious" clothing, the distinction made is without a difference because impervious clothing will be required for all employees on all occasions.

Employees required to wear such clothing will be subjected to almost intolerable work conditions because the clothing will produce much heat and discomfort. These conditions will also produce fatigue, reducing employee alertness. In addition, since such a suit would be impervious to VCM, a garment of

this type would tend to guarantee long-term exposure to VCM if, by chance, some of the gas entered the garment.

Use of gloves will diminish an employee's dexterity and would be objectionable for most jobs because operators will find it difficult to operate controls and keep records, and maintenance men, particularly instrument and electrical repairmen will not be able to perform their work safely and properly.

Thus, because of the reduction in employee efficiency due to the cumulative effects of fatigue, the dangers of unsure footing and decreased hand and finger movement, maintenance, repair and other such work will take substantially longer than what is now experienced. Increases in maintenance and repair time could foreseeably require certain production segments to shut down completely disrupting the entire production process.

Although the standard writers may have intended to protect employees from exposure to VCM by requiring them to wear protective clothing, ironically such clothing really does not afford an employee any more protection than if it were not worn. As a gas, air-borne VCM will not cling to clothing, skin or equipment. Residual VCM remaining in PVC resin would likewise dissipate into the air and not cling to the skin, clothing or equipment.

In view of the foregoing, it is not reasonable to dictate and require employees to wear protective clothing. Requiring employees to wear hot, cumbersome, uncomfortable and unsafe

impervious protective clothing would be expensive, dangerous, counterproductive and difficult to enforce.

The proposed standard also requires employees to remove all protective clothing at each exit from a regulated area. In the case of solid or liquid carcinogens, the dust of the liquid on the employee's clothing is the carcinogen itself or is made up in large parts of the carcinogen. In the case of PVC resin, the suspected agent VCM will be a very small part of the dust and will dissipate into the air in nearly undetectable concentrations. Consequently employee contact with VCM from dust on clothing is again virtually nonexistent.

Furthermore, to satisfy the requirement of removing protective clothing on each exit from a regulated area, employees will be forced to go to the locker room to change clothing before going for a break or for lunch and to return to such area to change back into protective clothing before returning to work.

Maintenance personnel will have to change each time they enter and leave a regulated area. Depending on the location of the change room and break room, this rule might easily consume one to two hours per day per man and much more in the case of those who successfully abuse the rule.

On the basis of the available medical and scientific evidence, the group of employees at maximum risk with respect to VCM induced angiosarcoma is the reactor cleaner group: those exposed to the highest concentration of VCM for the longest period of time. For many years, Firestone has been committed to reducing the exposure of reactor cleaners to VCM

by minimizing the number of times reactors must be cleaned by employees.

By continuously making process improvements, Firestone has introduced high pressure water systems to clean some reactors, sophisticated ventilation systems to remove VCM from reactors prior to employee entry, and extensive ventilating systems to insure atmospheres inside reactors at concentrations below 50 ppm VCM.

Over the years, Firestone has instituted in a major portion of its reactors at Pottstown cleaning system improvements which have reduced the need for employee cleaning of reactors from every one to two batches, or once a day, in some cases, to every 100 batches, or perhaps once a month while, at the same time, the vacuum and ventilating systems have reduced employee exposure to VCM inside those reactors to less than 50 ppm.

Completion of these procedures has practically been accomplished at Pottstown and will be implemented at the Perryville facility. Reactor ventilation is in use in both plants.

Firestone will continue to develop process improvements similar to those described above for minimizing employee cleaning of reactors and to reduce employee exposures there when such cleaning is required.

Although Firestone believes that this essentially technological approach to the problem of reactor cleaner exposure is the most effective means of minimizing health

hazards to employees, it also recommends, in order to insure that all steps have been taken to provide maximum protection available to its reactor cleaner employees in view of their identification as the group of maximum risk, that reactor cleaners wear protective clothing and gloves sufficient to protect them from skin contact with the material chipped and cleaned from reactor walls.

In referring to maintenance the proposed permanent standard requires that employees engaged in maintenance or repair operations on contaminated systems, or in vessel

entry, be provided with and required to wear whole-body air-supplied suits impervious to VCM and a respirator with a full face piece. This rule constitutes an extreme safety hazard.

Reactor cleaners must climb through a manhole-size opening and down a ladder into the vessel. They then must work on the curved bottom surface of the vessel, step over agitator blades and work from a ladder to clean the walls and dome. An air-supplied mask's trailing hoses constitute a safety hazard to employees engaged in these activities. The addition of a bulky air-supplied suit would further decrease an employee's mobility, balance, sure-footedness and efficiency.

The activities of maintenance employees working on contaminated systems or equipment wearing respirators and "space suits" can be as demanding and dangerous because they must work from platforms, climb ladders and be able to move around the equipment.

Furthermore, the perspiration generated by these suits will result in severe discomfort. Firestone's operating personnel estimate in a report attached to our statement of position that premium wages will be required to induce employees to wear space suits and that employee efficiency may well decrease as much as 75 percent when such suits are worn.

In fact, we have been advised by the Mine Safety Appliance Center, one of the largest manufacturers of space suits, that air suits, tested or certified to be used in the presence of

VCM are not available for purchase.

Finally, recognizing the fact that such "space suits" represent a safety hazard due to their cumbersomencess and lack of comfort, the Secretary did not require their use in the carcinogen standards. Commenting on this matter, the Secretary stated (39 Fed. Reg. 3759 (1974)):

"OSHA agrees with the many comments that a full impervious air-supplied suit is cumbersome while impervious garments with air-supplied hoods are adequate and more comfortable to the workers."

No explanation has been offered as to why there has been a reinstitution of the impervious air-supplied suits requirement for exposure to VCM. Such action is questionable because, as noted repeatedly, VCM does not cling to clothing or skin due to its volatile nature.

Consequently requirements for such suits should be withdrawn from the standard and only the requirement that clothing and gloves providing reactor cleaners protection from skin contact with material chipped and cleaned from the reactor walls be instituted.

The mandatory shower requirements of the proposed permanent standard are not necessary to protect against hazards from VCM exposure because VCM is a highly volatile substance which does not cling to skin or clothing. Splashes with liquid VCM almost never occur because of this volatility. Should any touch the skin, it will evaporate immediately leaving no VCM residue.

Indeed, the chemical property of VCM gas which renders a

shower requirement unnecessary in protecting against an exposure hazard has already been recognized by the Secretary in promulgating the previous carcinogen standard. In the background statement concerning shower requirements, the Secretary stated (39 Fed. Reg. 5759 (1974)):

"Principally volatile materials will not be present long enough for routine washing or showering to have effect as a protective measure. Thus, a requirement to wash on exit, and shower at the end of each day, would not offer any significant protection to employees working in areas with volatile materials. Trace amounts that might be absorbed onto exposed skin vaporize long before the employee would wash or shower."

As a consequence, to require employees to shower after being exposed to the highly volatile VCM would be in direct conflict with, and contrary to, the expressed position of the Secretary in the carcinogen standard. Showers are provided at the Firestone plants, but as an employee convenience, not a regulation.

Firestone's primary objection to the emergency provisions of the proposed permanent standard is the requirement that special medical surveillance by a physician shall be instituted within 24 hours for all employees present in an area at the time of an emergency, regardless of the amount of VCM which may have escaped during the emergency situation.

Additional surveillance after emergencies would result in an unreasonable burden on the employer and a nuisance to most employees. The requirement also has the potential of being abused by troublesome employees.

For example, an employee looking for a long break, an employee desiring to harass a supervisor or an employee just looking for a change of pace could easily simulate an exposure to VCM while not being monitored in order to be sent to the hospital or physician's office to begin his medical surveillance. If monitoring were too strict for a pretended exposure, a brief real exposure could easily be arranged.

Another major drawback to this requirement is that even a minor incident might require that half or all of the working crew report to a physician's office within 24 hours of the emergency. The safety of the plant might go completely begging while unqualified operators covered the jobs vacated by regular operators who were out of the plant beginning their medical surveillance.

Finally, any standard which requires employees to abandon an area where there may be an unexpected exposure to VCM and only permitting return to the area after employees have donned air respirators, would be unwise. Evacuating the area when an alarm sounds, and not remaining to see what has happened is a situation which must be avoided if any emergency is to be quickly, efficiently, and safely brought under control.

In emergencies it may often be more prudent to accept a brief exposure to VCM to avoid a larger exposure or a mushrooming hazard. It would be impossible to guess how many lives have been saved by prompt action in sealing off ruptured lines, closing valves and transferring batches from leaking reactors, action which would be prohibited if the proposed

standard is adopted.

Firestone has ordered and will install multipoint, constant, sequential monitoring systems which will plot on graph paper the level of VCM exposure. These graphs will show amounts of VCM released at all times and during any emergency.

Such a fixed system continuously checks many areas, and via its early warning capability greatly minimizes exposures. It continuously cycles monitoring samples to an infrared or chromatographic analyzer thereby producing instantaneous results indicating exposure levels in excess of that permissible. The only monitoring equipment currently available for the individual is the air bag or carbon tube sampler which require extensive testing through analytical procedures to determine the results. By the time such results have been analyzed they are after the fact in that the employee may already have been exposed to a level in excess of that permissible.

A fixed monitoring system permits the immediate feedback of monitoring results and where necessary could alarm personnel to high VCM concentration, pinpoint the area quickly, and permit employees to immediately don air masks. This is by far the best method to avoid or minimize exposure and, therefore, offers the best overall protection to all personnel.

Because a fixed monitoring system, in effect, also provides continuous reporting which will be available to OSHA compliance investigators and kept for 20 years, the special reporting requirements of the proposed permanent standard are unnecessary.

1711

In lieu of the monitoring and special reporting provisions required by the proposed standard, the Secretary should require utilization of a constant monitoring system which will provide all monitoring and information necessary for protection of employees.

As I said in the beginning, our written submittal covers in greater detail the problems associated with the work rules and includes some I have omitted. However, I believe I have given you the highlights of our objections to the work rules.

Thank You.

-END-

48(c)

39 South LaSalle Street
Chicago, Illinois 60603
312/[illegible]

Dated: June 25, 1971

TABLE OF CONTENTS

		Page
I.	GENESIS OF THE PROPOSED PERMANENT STANDARD DEALING WITH OCCUPATIONAL EXPOSURE TO VINYL CHLORIDE.	1
	A. Description of Polymerization Process of Vinyl Chloride Monomer to Polyvinyl Chloride and Employee Exposure to Vinyl Chloride Monomer in Those Processes . . .	1
	1. Properties of Vinyl Chloride Monomer.	1
	2. Polymerization of VCM Into PVC. . . .	2
	3. Employee Exposure	7
	B. History of Medical and Scientific Investigations Into Toxicity and Carcinogenity of Vinyl Chloride Monomer and Industry and Government Response Prior to the Issuance of the Temporary Emergency Standard	8
	C. The Issuance of the Temporary Emergency Standard	17
	D. The Promulgation of the Proposed Permanent Standard	22
II.	INDUSTRY AND MARKET DESCRIPTION: VCM AND PVC MANUFACTURERS; PLASTICS FABRICATORS; USERS. .	29
	A. Industry Structure--VCM Producers	29
	B. Industry Structure--Domestic and Foreign PVC Manufacturers	31
	C. Fabrication of PVC Resins	37
	D. The Market For Fabricated PVC Products. .	38
III.	FIRESTONE'S POSITION IN, AND RELATION TO, THE PVC INDUSTRY.	41
IV.	FIRESTONE PLASTIC COMPANY'S CONTINUING CONCERN FOR EMPLOYEE SAFETY AND HEALTH WITH RESPECT TO OCCUPATIONAL EXPOSURE TO VINYL CHLORIDE . . .	42

		Page
V.	PROCESS FOR PROMULGATION OF PERMANENT STANDARD DEALING WITH TOXIC MATERIALS OR HARMFUL PHYSICAL SUBSTANCES.	47
	A. Introduction.	47
	B. Legislative History and the Act	48
	1. Promulgation of Standards	48
	2. Judicial Review	50
	3. Developing Standards	51
	C. Judicial Review	56
	D. Conclusion.	63
VI.	AN OBJECTIVE ANALYSIS OF THE BEST AVAILABLE SCIENTIFIC AND MEDICAL DATA DEMONSTRATES THAT IT IS MEDICALLY AND SCIENTIFICALLY PRUDENT TO ESTABLISH THE LEVEL OF OCCUPATIONAL EXPOSURE TO VCM ABOVE THE "NO DETECTABLE LEVEL". . . .	64
	A. Existing Medical and Scientific Studies Are Inconclusive on the Issue of Appropriate Human Exposure Levels.	64
	B. If the Existing Medical and Scientific Data is the Sole Support for No Detectable Level of VCM Exposure, the Proposed Permanent Standard Will Not Withstand Judicial Scrutiny Under the Substantial Evidence Test	69
	C. Establishment of a No Detectable Level for Occupational Exposure to VCM Would be in Direct Conflict With, and Contrary To, the Previously Expressed Position of the Secretary in the 14 Carcinogens and the Asbestos Standards.	71
	D. A Carefully Considered Theory of the Onset of the "So-Called Vinyl Chloride Disease", Based on Human Observations, Suggests Early Diagnosis of the Disease Before Development of the Angiosarcoma Tumor and Possible Preventive Care to Impede, If Not Terminate, the Progression of the Disease.	74

E. Firestone's Medical and Scientific Studies of Its PVC Workforce Shows No Health Hazard Greater Than to be Expected in the Population as a Whole as a Result of Historical as Well as Present Low Level Occupational Exposures to VCM . . . 76

VII. THE PROPOSED PERMANENT STANDARD IS NOT TECHNOLOGICALLY FEASIBLE NOR ATTAINABLE IN THE POLYVINYL CHLORIDE INDUSTRY 81

A. Resume of the Proposed Permanent Standard 81

B. The Proposed Permanent Standard Is Not Achievable or Attainable Through Known Technology or the Adoption of Feasible Work Practice Methods. 86

C. Engineering and Technical Obstacles Prevent Immediate Reduction of Measurable Concentration of Vinyl Chloride in the Ambient Air Below 50 PPM; Further Graduated Reductions Can Be Achieved Only Through Extensive Capital Equipment Replacement Programs. 95

D. The Proposed Permanent Work Standards Are Not Feasible. 104

1. Scope and Application 104

2. Definitions 105

3. Regulated Areas 106

4. Monitoring. 107

5. Respiratory Protection 109

6. Protective Clothing 112

7. Reactor Cleaners 118

8. Hygiene Facilities and Practices . . . 120

9. Emergencies. 122

10. Signs and Labels 126

		Page
	10. Maintenance and Decontamination. . .	128
	11. Transportation Loading and Unloading	131
	12. Reports	133
	E. Economic Impact of the Proposed Work Standard Rules on Employee Productivity and the Need for Additional Personnel in Firestone's Facilities	133
	Conclusion.	137
VIII.	THE PROPOSED PERMANENT STANDARD IS NOT ECONOMICALLY FEASIBLE	138
	A. The Work Standards Are Counter-Producti	38
	B. The Proposed Permanent Standard Will Have Deleterious Effects on Industry Structure and Domestic Competition	143
	C. The Effects of the Proposed Permanent Standard on Foreign Competition	144
IX.	CONCLUSION: FIRESTONE'S PROPOSAL FOR A PERMANENT STANDARD REGULATING OCCUPATIONAL EXPOSURE TO VINYL CHLORIDE.	147
	A. Introduction.	147
	B. Exposure Limitations: Time Weighted Average (TWA) and Ceiling Values.	149
	C. Work Practice Rules	151
	1. Use of Respirators and Full Face-Pieces	152
	2. Protective and Impervious Clothing. .	152
	3. Sanitation.	153
	4. Monitoring.	153
	D. Medical Surveillance Procedures	154
	E. Ongoing Medical and Scientific Research .	154

PREAMBLE

Firestone's management is gravely concerned about the potential health hazard which may result from indiscriminate exposure to vinyl chloride monomer. Present medical and scientific data, however, do not justify the abrupt termination of an industry affecting hundreds of thousands of people which clearly will occur if the proposed permanent standard with respect to vinyl chloride is adopted.

Firestone's position with respect to this matter was reached with profound study and concern about the health aspects which may result from undue exposure to vinyl chloride monomer. As a result of the Company's intensive review and study of the medical problems that potentially exist and the severe impact adoption of the proposed standard will have on the industry, the Company has concluded that prudent and careful management of all VCM operations are required and that every technologically feasible method that can be employed to protect the people involved in the industry must be adopted.

Firestone is willing to expend all capital necessary for the research, development and implementation of those pro-

cedures which will reduce employee exposure to vinyl chloride monomer to the lowest technologically feasible level.

Because the exposure levels of the proposed standard are however technologically unachievable, a reasonable and medically prudent exposure level must be selected with the intent of protecting the health and safety of all engaged in the industry. A reasonably achievable and feasible exposure level, in conjunction with safe and practical work practice rules must be adopted with, of course, the overriding consideration being attainment of the most limited exposures of VCM to industry employees.

Firestone submits that a safe and medically sound, as well as a technologically and economically feasible, standard is that which provides for a 25 ppm TWA and 40 ppm ceiling exposure level. Close and careful adherence to this level with appropriate and adequate work rules will assure safe working conditions without destroying the entire industry. These levels, if properly implemented and enforced, will minimize occupational risks and afford industry and the engineering community opportunities to

develop more sophisticated and advanced techniques which can be employed further to reduce vinyl chloride levels in the ambient air.

The exposure level standard which Firestone proposes, 25 ppm TWA coupled with a 40 ppm ceiling, is not one which is immediately achievable nor a level which can be accomplished without the expenditure of millions of dollars at Firestone alone. However, it is technologically achievable and although one which will have severe economic consequences on the polyvinyl chloride industry, is a level under which the industry can survive. This exposure level should be maintained as the permanent standard until further ongoing medical experimentation and study, of the human as well as animal experience, is completed and more definitive conclusions have been reached concerning the nature and consequences vinyl chloride monomer may have on industry employees.

VI. AN OBJECTIVE ANALYSIS OF THE BEST AVAILABLE SCIENTIFIC AND MEDICAL DATA DEMONSTRATES THAT IT IS MEDICALLY AND SCIENTIFICALLY PRUDENT TO ESTABLISH THE LEVEL OF OCCUPATIONAL EXPOSURE TO VCM ABOVE THE "NO DETECTABLE LEVEL."

A. Existing Medical And Scientific Studies Are Inconclusive On The Issue Of Appropriate Human Exposure Levels

A common thread unites all of the known scientific and medical research into the carcinogenic effects of VCM exposure with respect to liver angiosarcoma in humans: Key experiments remain to be completed before any determination can be made with respect to the effects of low level human occupational exposure to VCM. Except for the Tabershaw-Cooper epidemiological study to be discussed below, all of the recent scientific studies on which the exposure level in the permanent standard will be based were done on animals, primarily rats and mice. There are no recent reported studies involving VCM exposure to higher level animal species which have metabolic systems more closely akin to man's, such as dogs or monkeys. Furthermore, no scientific study exists which establishes to what degree, if any, studies of the carcinogenic effects on rats and mice can be extrapolated to humans, although the National Cancer Institute's Ad Hoc Committee on The Evaluation of Low Levels of Environmental Chemical Carcinogens in 1970 recommended that humans not be

exposed to substances shown to be carcinogenic in at least two species of animals. As the attached report of Dr. Marvin Kuschner, Dean of School of Medicine, and Chairman of The Department of Pathology, State University of New York at Stony Brook indicates (Appendix 163), there is not only an enormous difficulty in interspecies extrapolation with specific respect to the preliminary animal findings at high levels of exposure (2500 ppm) as reported by Maltoni and Bio-Test but also it is entirely proper to inquire into the possiblity that man is considerably less susceptible to angiosarcoma than rodents exposed to VCM.[82] Consequently, recent reports of Maltoni's findings of angiosarcoma in mice at 50 ppm and Bio-Test's reports of finding angiosarcoma in mice at the same level cannot be evaluated or accepted as conclusive or definitive because the studies involved have not been completed and because of the serious difficulties presented in regard to extrapolating the animal findings in Maltoni's study to the findings of Bio-Test's study.

Similarly, the human experience to date is less than definitive. The Tabershaw-Cooper epidemiological study found a not statistically significant excess of deaths from angiosarcoma of the liver, brain, respiratory and lymphatic

---

82 / It has been suggested by Maltoni himself at a meeting of the New York Academy of Sciences on May 10-11, 1974 that the ages at which the mice which he observed develop the angiosarcoma tumor at 50 ppm were equivalent to a human who developed a tumor at 70-80 years of age after being occupationally exposed to VCM over a normal working lifetime.

systems in workers exposed to VCM, but a less than expected death rate, compared to the population as a whole, from all causes.

The fact that human deaths of 16 PVC workers worldwide who were exposed to VCM have been confirmed as attributed to angiosarcoma is cause for considerable concern.[83] Of great significance, however, is that 5 of the 10 deaths in the United States occurred in employees who had been employed in B. F. Goodrich's Louisville plant. Moreover, two cases of angiosarcoma were observed in living employees who worked in B. F. Goodrich's Louisville plant. Thus, 7 of 13 cases of angiosarcoma attributed to VCM in the United States--more than half--are associated with Goodrich's Louisville plant. Also of significance is a report that 12 of the 13 confirmed cases of VCM induced angiosarcoma in PVC workers in the United States--dead and living--were observed in employees who had worked cleaning reactors and were therefore exposed to the highest concentrations of VCM in a PVC plant. Again, the known fact that the angiosarcoma tumor causes death after more than 14 years exposure to VCM; the fact that human occupational exposures to VCM during the period in which the 16 humans who died were exposed were many times greater than they are now; and the significant cluster of deaths at Louisville all suggest that extensive study should be undertaken to determine if unique conditions causing extraordinary exposures, particularly with respect to employees cleaning reactors, at Goodrich's Louisville plant some time ago existed, and explain the cluster of human deaths observed.

83/ Appendix 170, NIOSH, Confirmed Cases of Liver Angiosarcoma Among PVC Workers.

Clearly, the human deaths caused by admittedly high levels of VCM exposure not now permitted in Firestone's plants or industry generally suggest nothing with respect to the effects on humans of the low levels of VCM exposure presently permitted in Firestone's plants and in the industry generally. That is, on the basis of the existing studies, it is not scientifically or medically known whether continued present low levels of VCM exposure will result in angiosarcoma in a human being, whether or not that human has been exposed to the high concentrations in the past which have now been eliminated. Further, it may be hypothesized that there would be a substantially higher death rate than has been observed in the industry if historical exposure levels in American industry were dangerous to employees.

Moreover, as the attached report of Dr. Thomas H. Milby, Adjunct Associate Professor of Occupational Medicine and Environmental Health at the School of Public Health, University of California shows (Appendix 157), the existing scientific data indicate that, at most, VCM is a weak carcinogen rather than a potent one in humans and animals. In the context of other studies in the area of carcinogens which demonstrate that below certain amounts of a single or cumulative dosage, no detectable harm is caused, or the extent of harm is of no practicable importance because the latency period prior to manifestation of harmful effects will be of greater duration than the normal lifespan of man,[84/] it is reasonable to

---

84/ See Carcinogens, 39 Fed. Reg. 3758 (1974).

conclude, as Dr. Milby did, that it is possible to work with VCM in relative safety at the low exposure levels achievable by industry, particularly in view of the relatively small number of deaths attributed to VCM as compared with other potent carcinogens and the relatively long latency period presently observed in connection with development of the angiosarcoma tumor.

In addition to the fact that no studies or research have been done to ascertain the effects of present low level VCM exposure on humans, no scientific or medical study or report has shown that angiosarcoma of the livers of rats and mice is caused by exposures to VCM in concentrations below 50 ppm. Although it would seem reasonable that threshold values and dose response relationships will eventually be developed with respect to carcinogensis generally, the particular values and relationships associated with VCM induced angiosarcoma are not now known.

Consequently, it is clear that the state of scientific and medical knowledge available in this area is in its early stages, and insufficient for the purpose of basing an opinion as to the appropriate occupational exposure to VCM at levels below 50 ppm or even as to the risk of occupational exposure to VCM if the exposure level were established at 50 ppm. There is not sufficient knowledge to conclude that safe

levels of VCM exposure do not exist and it is the opinion of knowledgable experts like Dr. Kuschner, Dr. Milby and Dr. Michael M. Baden, Deputy Chief Medical Examiner, City of New York and Associate Professor, Department of Forensic Medicine, N.Y.U. School of Medicine (see attached report Appendix 185), after review of existing medical and scientific studies, that it is entirely possible that as yet undetermined safe levels of exposure do exist. Speculation of a medical and scientific nature as to a specific appropriate level of VCM occupational exposure between 0 and 50 ppm for humans, based as it must be on inconclusive and uncompleted scientific and medical studies on the effects of low level VCM exposure, is, therefore, without adequate foundation, entirely conjectural, and has no medical relevancy at this time because there are no facts to support any specific number.

B. If The Existing Medical And Scientific Data Is The Sole Support For No Detectable Level Of VCM Exposure, The Proposed Permanent Standard Will Not Withstand Judicial Scrutiny Under The Substantial Evidence Test

Under the standards for judicial review as explicated in Industrial Union Department, AFL-CIO v. Hodgson, 1 OSHC 1631, ___F. 2d ___, (D.C. Cir. 1974), the no detectable exposure level proposed as a permanent standard will not withstand judicial scrutiny. The decision of the Court of

Appeals for the Eighth Circuit in Reserve Mining Company v. United States, ___F. 2d ___, No. 74-1291 (1974), on motion for stay of injunction pending appeal, is instructive in this respect. In that case enforcement proceedings under the Refuse Act, the Federal Water Pollution Control Act and the federal common law of public nuisance were invoked to enjoin Reserve from discharging taconite tailings (asbestos-like fibers) into Lake Superior and into the atmosphere surrounding Reserve's plants. The issue joined on the motion for stay of the lower court's injunction requiring a shutdown of Reserve's plant was essentially the same as it is here -- whether the current state of medical knowledge was sufficient to demonstrate a health hazard from exposure to taconite tailings justifying a determination to completely shutdown Reserve's operations. As here, the state of medical and scientific knowledge available was in its early stages and insufficient for the purpose of basing an opinion as to the magnitude of risks associated with the levels of exposure to asbestos-like fibers in the case. The Court specifically found that although Reserve's discharges represent a possible medical danger, the nature of the health hazard was unknown. Because of the absence of knowledge, an assessment of the health risk was simply impossible. Consequently, the Court concluded that Reserve would ultimately prevail on the issue that no health hazard existed, as follows:[85/]

> "It cannot be said, other than as a matter of conjecture, that the discharges will result in any higher

85/ Slip op. at p. 25.

> incidence of disease than that experienced by a general public not similarly exposed. Although we are sympathetic to the uncertainties facing the residents of the North Shore, we are a court of law, governed by rules of proof, and unknowns may not be substituted for proof of a demonstrable hazard to the public health."

The state of medical and scientific knowledge herein is in an even earlier stage than in the Reserve Mining case, where the record included a number of studies of the effects on humans of exposure to asbestos as well as a court ordered human tissue study to ascertain the effects of ingestion rather than inhalation of asbestos. A permanent standard embodying a no dectectable VCM exposure level based on the existing inconclusive and uncompleted medical and scientific evidence herein will not be supported by substantial evidence under the teachings of Industrial Union Department v. Hodgson and Reserve Mining.

C. Establishment Of A No Detectable Level For Occupational Exposure To VCM Would Be In Direct Conflict With, And Contrary To, The Previously Expressed Position Of The Secretary In The 14 Carcinogens And The Asbestos Standards

Section 6(b)(5) of the Act requires the Secretary to consider experience gained under the Act and under other health and safety laws in issuing a standard for occupational exposure. Establishment of a "no detectable level" of VCM exposure based on the inconclusive and uncompleted scientific

and medical studies herein would clearly be arbitrary and capricious, in view of the stated position of the Secretary under the Act with respect to the 14 carcinogens. There, the Secretary rejected the concept that the carcinogen standard should not allow any exposure, as follows:[86]

> "We agree with the Ad Hoc Committee on the Evaluation of Low Levels of Environmental Chemical Carcinogens that a safe level of human exposure to any of the 14 carcinogens cannot be established by application of present knowledge. But we are not prepared to draw from this state of knowledge the conclusion that such levels do not exist. First, it is the professional opinion of many knowledgeable people that as yet undetermined safe levels of exposure possibly do exist. Also, a conclusion that safe levels do not exist seems questionable in view of other studies, some in the area of carcinogenicity which demonstrated that below a certain amount of a single or cumulative dosage, no detectable harm is caused, or if harm is caused, the extent of such harm will be of no practicable importance because the latency period prior to manifestation of harmful effects will be of greater duration than the normal lifespan of man. Secondly, no possible exposure to the carcinogens under any circumstances could only be guaranteed by a total ban on the manufacture, use (even for cancer research), and transportation of the substances. As long as the substances are used, exposure to some amounts may occur because of breakdown of equipment or human error. Accordingly, the intent of the standards is to reduce exposure of workers to any of the listed substances to the maximum extent practicable consistent with continued use."

86/ 39 Fed. Reg. at 3758 (1974).

The same concept guided the Secretary in issuing the standard for occupational exposure to asbestos. There, as here, "the dispute is as to the determination of a specific level below which exposure is safe."[87/] The exposure standard was not established at a no detectable level even though known human deaths from occupational exposure were in the thousands, far exceeding the deaths from occupational exposure to VCM and available medical and scientific evidence was much more conclusive than that involved herein.

Furthermore, health and safety standards for occupational exposure to radioactive materials, recognized as harmful carcinogens, under the Atomic Energy Act[88/] have not been set at no detectable levels. Instead, the standards have set limits for exposure above detectable levels, coupled with specified time periods for such exposure.[89/]

To affirm a no-detectable level for VCM exposure in these proceedings would be entirely lacking in reason and consistency of administrative regulation in view of the more serious health hazards associated with radioactive materials, asbestos and the 14 carcinogens (as shown by higher incidence of human death connected therewith), where

---

87/ 37 Fed. Reg. 11318 (1972).

88/ 42 U.S.C.A. §2201 et seq. (1973).

89/ 10 CFR §20.1 et seq. (1973).

non-detectable levels were not established, and were, moreover, rejected. Under these circumstances, a determination by the Secretary establishing a no-detectable level for VCM exposure would be rejected as arbitrary, capricious, and entitled to no weight under the Supreme Court's seminal pronouncement with respect to the agency decision making process in Skidmore v. Swift & Co., 323 U.S. 134, 140 (1944):

> "The weight of such a judgment [i.e. the administrative determination] in a particular case will depend upon the thoroughness evident in its consideration, the validity of its reasoning, its consistency with earlier and later pronouncements, and all those factors which give it power to persuade, if lacking power to control."

D. A Carefully Considered Theory Of The Onset Of The "So-Called Vinyl Chloride Disease," Based On Human Observations, Suggests Early Diagnosis Of The Disease Before Development Of The Angiosarcoma Tumor And Possible Preventive Care To Impede, If Not Terminate, The Progression Of The Disease

In December 1973, a German group of scientists--Juhe, Lange, Stein and Veltman--reported on a study of 13 humans exposed to VCM. Although one of the few studies of human exposure to VCM and although the study itself was carefully done and of monumental significance in terms of its implications, it was not mentioned in either the temporary emergency standard or the proposed permanent standard.

After exhaustive and thorough examinations of the humans, the Juhe group declared that the pathogenesis of the disease was as yet unexplained, but that the symptoms observed in humans suggested that the cause of the disease could be attributed to obstruction of connective tissue or blood vessel connective tissue which then developed into blood circulation disturbances and finally into a systemic disease, a syndrome involving the participation of numerous organs in the body.

The significance of this human study, in the context of the inconclusive results of the animal studies is apparent. The study of the Juhe group indicates that the so-called vinyl chloride disease may be identifiable in its early stages prior to development of the angiosarcoma tumor by appropriate medical surveillance and lends real basis for concluding that proper measures can be taken upon discovery of the early symptoms to arrest the later stages of the disease so that the development of the angiosarcoma tumor would occur, if at all, only after man's normal life expectancy, or to terminate the disease before its later symptoms ever develop.

Because, as noted above, speculation of a medical and scientific nature as to the appropriate level of VCM exposure below 50 ppm is basically conjecture or academic, the

emphasis in establishing a permanent standard for occupational exposure to VCM should be primarily placed, not on fixing an immutable level for VCM exposure, but on work practices and medical surveillance procedures in an attempt to identify the early symptoms of the disease and to provide appropriate action to arrest or terminate the disease, such as indefinite or permanent withdrawal or rotation of a worker exhibiting early symptoms from further occupational exposure. In sum, the significance of the study by the Juhe group is that, in view of the inconclusive medical and scientific evidence of low level VCM exposure, even an exposure of 50 ppm could be tolerated, provided that appropriate medical procedures were also required to identify early symptoms of the disease and to withdraw workers exhibiting those symptoms from further exposure.

E. Firestone's Medical And Scientific Studies Of Its PVC Workforce Show No Health Hazard Greater Than To Be Expected In The Population As A Whole As A Result Of Historical As Well As Present Low Level Occupational Exposures To VCM

Firestone has undertaken two studies of its PVC workforce in order to determine what hazards, if any, exist with respect to the low levels of VCM exposure currently permitted in its PVC plants.

First, Firestone is actively and vigorously evaluating all of its deceased employees who worked at its Pottstown facilities since they began operating in 1947, including Firestone's

Tire plant, plastic fabricating and PVC facilities there. Dr. Michael M. Baden, Deputy Chief Medical Examiner City of New York and Associate Professor, Department of Forensic Medicine, and Dr. Bernard Pasternack, Department of Environmental Medicine, N.Y.U. School of Medicine have undertaken at Firestone's request, a study of the death certificates of Firestone's Pottstown employees who have died since operations commenced there to determine if the causes of death of any of Firestone's employees in Pottstown, other than the one death already reported, were listed as being caused by or suspected as being caused by angiosarcoma of the liver; and to compare the causes of death of all of Firestone's employees at Pottstown.

The preliminary findings of Dr. Pasternack's proportional study of workers exposed to vinyl chloride 1947-74 and Dr. Baden's findings and conclusions based thereon which also included evaluation of hospital records and histologic slide material are attached as Appendix 185 . The preliminary findings of these studies is summarized as follows:

1. Of the deceased employees who worked in Firestone's PVC facilities and who were exposed to VCM (85 of the 87 deaths since 1947 were evaluated) only the death of the one employee previously reported was caused by angiosarcoma of the liver.

2. There was no significant increase in deaths from any specific malignancy, comparing the employees who worked in Firestone's PVC facilities and were exposed to VCM with those who worked in the tire facilities

and were not exposed to VCM. A slight excess of cancer of the respiratory and digestive systems present in both groups when compared to the total United States white male population must be further examined as to smoking habits of these groups and other local environmental factors.

3. An examination of Firestone's living employees at its Pottstown facilities is necessary to evaluate Doctor Pasternack's finding that the mean age of death from all causes for employees exposed to VCM was less than the employees who were not exposed to VCM because there may be reasons for this difference other than exposure to VCM. Thus, the median age of death of those dying of cancer in the exposed group of employees is the same as the median age of death of those dying of cancer in the group of employees not exposed to VCM and there is no greater number of early deaths from cancer in the group of employees exposed. In the group of employees exposed to VCM the oldest death from cancer was 67; in the group not exposed 19 deaths from cancer occured between 71 and 87 years of age. This difference, according to Dr. Baden, may be an artifact caused by initial population age differences which should be explored further.

4. There is no difference in all causes of death among the 32 deceased employees who were exposed to VCM for more than 10 years as compared with the 53 deceased employees who had shorter exposures. Among the 22 malignancies in the group of employees exposed to VCM there is no difference in type of cancer in those exposed more or less than 10 years (except for the 1 angiosarcoma previously identified in the longer exposed group).

5. Although there was a slight excess of lung cancer in the Firestone population in both the exposed and non-exposed groups and although a not statistically significant higher incidence of lung cancer was observed in the employees exposed to VCM who died than would be expected, the significance of these findings can only be evaluated after obtaining adequate smoking histories.

6. Based on a review of the Tabershaw-Cooper study in addition to other scientific studies, particularly those of Viola and Maltoni and on the review of the Firestone death certificate materials, Dr. Baden concluded: "The issue of threshold still remains to be resolved but there may be a level beneath which exposure to vinyl chloride is not harmful."

Second, physical examinations and an exhaustive set of liver function tests are being performed on Firestone's current Pottstown PVC employees. Although superhuman efforts have been expended by Firestone's medical department and the Department of Pathology, Northwestern University Memorial Hospital, no results are available for reporting at the hearing on the permanent standard. It is believed that the results of these tests and examinations will show no liver abnormalities in the PVC and plastic fabrication employees significantly different than expected in a population not exposed to VCM.

Firestone's own studies of its PVC workforce demonstrate that the levels of VCM exposure permitted historically in its plants as well as the low exposure levels now permitted have not resulted in a health hazard to its employees sufficiently serious to justify a no-detectable level of exposure in Firestone's PVC plants.

VII. THE PROPOSED PERMANENT STANDARD IS NOT TECHNOLOGICALLY FEASIBLE NOR ATTAINABLE IN THE POLYVINYL CHLORIDE INDUSTRY

A. Resume of the Proposed Permanent Standard

The permanent standard for occupational exposure to vinyl chloride, as proposed by the Occupational Safety and Health Administration of the Department of Labor ("OSHA") on May 10, 1974 (29 CRF Part 1910), is much more restrictive and comprehensive than the provisions of the emergency temporary standard adopted by OSHA on April 5, 1974. The proposed standard prohibits employee exposure to vinyl chloride at concentrations above detectable levels which is to be determined by sampling and analytical methods capable of determining vinyl chloride at concentrations of 1 PPM with an accuracy of 1 PPM plus or minus 50 percent. Thus, in effect, the standard fixes a level of .05 to 1.5 PPM as the maximum exposure permitted to workers engaged in the vinyl chloride industry (§1010.93q(a)).

To minimize the number of persons exposed to vinyl chloride, the proposed standard defines certain regulated areas, access to which is limited to specified authorized employees and representatives (§1910.93q(c)(2)). The regulated areas are defined to include every location where vinyl chloride is manufactured, reacted, released, repackaged, stored or used; it also includes areas where polyvinyl chloride, capable of releasing

detectable levels of vinyl chloride, is manufactured, reacted, released, repackaged, stored or used (§1910.93q(c)(4)).

The proposed permanent standard also requires that a monitoring program be established in every regulated area for detectable levels of vinyl chloride. Although the standard is silent as to the type of monitoring that is to be carried out, it is required that the monitoring be of such type as would assure determination of employee exposure on an individual basis and that such monitoring be of such type as will assure determination of employee exposure on an individual basis and that such monitoring system have a confidence level of 95 percent (§1910.93q(e)(2)).

The proposed permanent standard requires every employer to undertake, as soon as practicable, a program to reduce airborne concentrations of vinyl chloride below the detectable level, or to the greatest extent feasible, solely by means of engineering controls and work practice methods. It is further required that such programs be accomplished "as soon as feasible" (§1910.93q(f)(iv)). As stated in the official comments to the proposed standard, engineering controls and work practices are the favored methods of compliance because their adoption will tend to avoid contamination of the ambient air in the work place. Pending institution of such controls through engineering means or work practice programs, a respiratory protection program is required to be established and implemented (§1910.93q(f)(iii)).

The respiratory protection program requires that employees shall be supplied with and wear a full face-piece respirator of the continuous flow or pressure demand type while working in regulated areas where there are detectable levels of vinyl chloride.

The standard further requires that all employees entering regulated areas be provided with and be required to wear protective clothing while in such areas. Full-bodied protective clothing, footwear or shoe covers and gloves are required to be worn in areas where detectable levels of vinyl chloride are present; in those areas where polyvinyl chloride powder, containing detectable levels of vinyl chloride is handled, employees are to be provided with and to wear head coverings. Such protective clothing is to be removed each time an employee leaves a regulated area and is to be replaced with clean protective clothing by the employer not less frequently than weekly (§1910.93q(h)).

The standard also contains provisions concerning hygiene facilities and practices. Among these are requirements that each employee working in a regulated area be required to shower after the last exist of the day and also that the employer provide change rooms and shower facilities for employee use. The storage or consumption of food or beverages, the storage or use of smoking or non-food chewing products and the storage or application of cosmetics in regulated areas are prohibited §1910.93q(i)).

The standard also regulates maintenance and repair operations, and provides for decontamination procedures in the event of accidental spills and other emergencies. With respect to maintenance and repair operations on contaminated systems or equipment, including vessel entry for purposes of cleaning, employees engaged in such operations are to be provided with and required to wear a whole-body air-supplied suit impervious to vinyl chloride and also a continuous flow or pressure demand type of full face-piece respirator or breathing apparatus.[90/] Employees who have been involved in such operations are required to shower after removal of the protective equipment and clothing (§1910.93q(l)). In emergency situations, hazardous conditions created by the emergency shall be eliminated and the affected area shall be decontaminated prior to resumption of normal operations. Where an employee has had contact with liquid vinyl chloride, he is required to shower as soon as possible. In addition, each employee present in an affected area at the time of the emergency is required to be given special medical surveillance within 24 hours (§1910.93q(j)).

90/ When vessels are to be entered, all piping is to be opened, blanked and tagged or if welded piping is in use closed and secured by not less than two valves in a series. No employee is permitted to enter a vessel except when another employee is present and observing the employee in the vessel with means for signaling for help in the event problems are encountered (§1910.93q(7)(ii)).

Specific provisions of the permanent standard also require specialized vapor-equalized transfer lines and vent connections at all facilities for the loading and unloading of vinyl chloride to and from containers.[91/] Employees engaged in such operations are required to wear full face-piece air-supplied respirators (§1910.93q(m)). In those instances where polyvinyl chloride containers might release detectable levels of vinyl chloride, such containers are required to be opened and the contents transferred only under local exhaust systems designed to reduce concentrations of vinyl chloride below the detectable level. The same requirements apply to hot operations involving polyvinyl chloride such as milling, calendering and extruding (§1910.93q(n)).

Other provisions contained in the permanent standard include those which require comprehensive medical surveillance programs including bi-annual medical examinations for employees who have been involved in vinyl chloride related operations for ten years or more and annual medical examinations for all other employees entering regulated areas. Similar medical examinations, with special emphasis on liver and spleen conditions and on bio-chemical determinations of liver functions, are also to be administered at initial employment. A complete and accurate

---

91/ Transfer lines are required to be cleared through the use of an inert gas system (§1910.93q(m)).

record of the results of medical examinations are required to be maintained for the duration of employment plus five years or for 20 years, whichever is longer (§1910.93q(o)).

Additional requirements under the standard deal with signs and labels which must be posted in regulated areas as well as on containers in which vinyl chloride or polyvinyl chloride are packaged or stored. Extensive recordkeeping of monitoring and measuring, medical reports and regulated area entry rosters and summaries are required to be kept and maintained by employers. The standard also requires extensive reports to the OSHA Area Director, including reports of incidents which result in the release of vinyl chloride into any area where employees may have been exposed and are required to incorporate detailed explanation as to the cause and action to be taken to prevent recurrences (§1910.93q(p)(q)).

B. The Proposed Permanent Standard Is Not Achievable Or Attainable Through Known Technology or the Adoption of Feasible Work Practice Methods

There is not one statement or reference to any technical authority in the proposed permanent standard indicating that the non-detectable exposure levels of vinyl chloride required by the standard can be technologically achieved in the manufacture of polyvinyl chloride. Nevertheless, the official preamble or comments preceding the standard states:

> "Engineering controls and work practices are favored methods of compliance because they tend to avoid contamination of the ambient air in the workplace. Accordingly, it is proposed to require the institution of engineering controls and of workpractice methods as soon as feasible, and to require the use of respirators pending the institution of such controls * * *." (F.R. Vol. 39, No. 92, p. 16897)

The standard itself emphasizes the importance of providing non-detectable levels of exposure in the workplace through engineering controls and work practice methods by making it mandatory that reductions of vinyl chloride concentrations be accomplished solely through such means. Paragraph (f)(iv) reads:

> "In any case covered by paragraph (f)(1)(ii) or (iii) of this section, the employer shall also undertake as soon as practicable a program to reduce airborne concentrations of vinyl chloride below the detectable level, or to the greatest extent feasible, solely by means of engineering controls and workpractice methods and as soon as feasible." (Emphasis added)

Implicit in the above statements is that there are engineering and technological means which can be employed by manufacturers of vinyl chloride and polyvinyl chloride--as well as by fabricators of finished polyvinyl chloride products--to prevent disbursement of detectable levels of vinyl chloride into the ambient air of their respective plants. The actual fact is to the contrary. On the basis of the best engineering and technological information presently available, it is

generally accepted that it is not feasible, if not impossible, to design a new plant or to convert and upgrade existing plants and facilities to meet the severe exposure levels demanded by the proposed permanent standard.

Firestone Plastics Company has long been engaged in improving working conditions and in making process and equipment changes to provide safe and efficient facilities. In order to determine whether the proposed permanent standard is technologically attainable, the Company instituted special technological and engineering studies designed to determine whether the present polyvinyl chloride plants of the Company located in Pottstown, Pennsylvania and Perryville, Maryland, could be modified and upgraded through process and equipment changes to meet the non-detectable ambient air exposure levels required by the standard.[92/] In addition, studies were undertaken to determine if it is technologically feasible and practical to adopt work practice methods to achieve and maintain non-detectable concentration levels of vinyl chloride in the Company's plants. An integral aspect of these studies was the economic impact resulting from implementation of such equipment and process modifications, the effects on production from implementation of engineering controls and work practice methods, and the effects

---

92/ In carrying out these studies, the Company obtained the services of independent engineering consultants, Catalytic, Inc., to provide capital cost estimates of the specified modifications to the Pottstown and Perryville facilities in attempting to meet employee exposure levels as required by the standard. (Appendix p. 131)

on employee safety and morale resulting from adoption of the proposed work practice rules as well as the potential effects on personnel turnover and manpower requirements.

In addition, the Company engaged the services of a professional engineering consultant, Dr. Frederick B. Higgins, Jr., an Associate Professor of Environmental Engineering Technology and Chairman of the Departments of Environmental Engineering and Civil Engineering Construction Technolcgies at Temple University, to conduct a study and to determine whether a new polyvinyl chloride plant employing the most advanced and sophisticated engineering techniques and equipment could be designed and constructed to achieve a non-detectable level of exposure as required by the proposed permanent standard.

The clear conclusion resulting from the studies carried out by the Firestone engineering staff in conjunction with Catalytic, Inc. is that Firestone would have no alternative but to cease all polyvinyl chloride manufacturing operations if the proposed standard is adopted. The studies by the engineering and production staffs at Firestone's Pottstown and Perryville plants indicate, independent of economic considerations, and despite enormous equipment, engineering and process changes at both of Firestone's facilities, costing in excess of $50,000,000, it is not possible to achieve the drastic exposure levels required by the proposed standard based on engineering controls and

technology that presently exist. Thus, the study of the Pottstown plant concludes, in part:

> "Based on the foregoing comments, Firestone would have no alternative but to cease operations when the proposed standard becomes law. An intensive engineering study would be necessary to determine whether a significant portion of the plant could ever be brought into compliance based on the engineering controls and technology that presently exist. Certainly one must question whether investment of additional new capital greater than the total fixed asset value of a twenty-seven year old facility is economically prudent." (Appendix, p. 36)

And, in summarizing the effects of adoption of the standard at the Perryville plant, the report states:

> "We have employed the most advanced engineering technologies and system designs presently known or anticipated in our study, but there are so many complex engineering factors involved it cannot be predicted whether any exposure level below 50 ppm can be reached until after the equipment has been installed and the design changes accomplished. However, in the judgment of our staff, it is technologically impossible to meet the non-detectable exposure level required by the proposed standard through engineering and technological means regardless of the amount of capital expenditures that might be made to improve and upgrade our plant." (Appendix, p. 69)

Dr. Higgins' study and report, a copy of which is included in the Appendix at pages 196 to 216, confirms the conclusions reached by Firestone's engineering and technological staffs.

After analyzing the problems encountered in attempting to design and construct a new plant to meet a non-detectable level standard, Dr. Higgins concludes that it is not possible to predict--even if such a plant were designed and constructed--that it would be capable of operating at the non-detectable level. Attempting to provide engineering controls in the PVC industry to reach the "no detectable levels" in even a new plant would require pushing to the limits of available technology and would require an enormous investment of capital. Many of the anticipated problems can be overcome only through use of specially designed equipment and newly created engineering processes.

The conclusions reached with respect to a new plant focus upon and highlight the technological obstacles with which the PVC industry will be confronted in attempting to meet the exposure levels of the proposed permanent standard. Certainly, if technology and engineering is inadequate today to provide an economical and technologically feasible new plant, it is obvious that existing PVC plants, many of which are in excess of 20 years or older, cannot be modified and upgraded merely through "engineering controls" to achieve a non-detectable exposure level.

With respect to Firestone's existing Pottstown plant, Dr. Higgins reported that the physical restrictions and the heavy

investment in major equipment would limit the application of many control techniques. "Substantial improvement in air quality may be attainable through careful engineering and construction, but the terms of the proposed regulation as written probably cannot be met technically in an existing plant and certainly cannot be met economically." Dr. Higgins suggests that unless a higher permissible exposure level concentration is adopted, all plant employees would be required to wear air-supplied air masks and protective clothing during a reconstruction program of several years. This would, according to Dr. Higgins, make operation of the plant very difficult if not practically impossible.

The engineering studies and conclusions carried out with respect to Firestone's plants are equally applicable and relevant to a majority of the PVC plants presently in operation in the United States. As noted, the age and condition of the other plants in the industry are comparable in age and condition to Firestone's 27-year old plant at Pottstown, Pennsylvania, and its newer 6-year old plant at Perryville, Maryland. The equipment and process changes at these plants to reduce vinyl chloride concentrations substantially and reliably forecast the improvements and changes which will be required at comparable PVC plants in the United States. Moreover, the costs of such improvements and equipment changes at other PVC facilities attempting to achieve lower levels of exposure consistent with the

proposed work practices would be substantially the same as at Firestone excepting only, perhaps, differences dictated by plant capacities, product mix and/or age.

The Firestone studies, confirmed by the economic review carried out by Catalytic, Inc., indicate that between 50 and 55 million dollars would have to be expended by Firestone alone in attempting to achieve the non-detectable level standard.[93/] The total capital investment to date at the Firestone plants is $49,682,000. Thus, even disregarding the effects the severe work practice rules will have on production and profits, Firestone would be compelled to make an election between closing its plants or doubling its capital investment in its PVC plants in order to continue operating. That these are the only two realistic alternatives which will confront Firestone management if the proposed standard is adopted is conclusively demonstrated by the engineering studies alone.

Catalytic, Inc. estimated that the equipment and process changes required in an attempt to achieve a non-detectable level at Firestone's Pottstown plant would cost $30,000,000. At its Perryville plant, Firestone would be compelled to expend $19,000,000 to improve a plant that is only 6 years old to reach the proposed exposure levels. The glaring harshness of the

---

93/ The estimated costs of the capital improvements and engineering changes at Firestone's plants have been determined on the basis that full compliance with and implementation of the engineering controls and work practice methods specified in the proposed permanent standard will be required regardless of the exposure level ultimately selected.

standard is reflected in Firestone's new PVC expansion at Perryville which is still under construction. It would require an additional investment of $6,500,000 to try and bring it within the framework of the proposed standard.

Under these circumstances, and especially when the magnitude of lost production and additional operating costs are considered, it is obvious that management could not rationally conclude that the additional expenditures were prudent or economically feasible. Because essentially the same technological and economic problems confront other PVC manufacturers, it is apparent that the management of all concerns will be compelled to reach the same conclusion.

The Act requires the Secretary to adopt feasible standards which have been understood by the courts as well as the Secretary to encompass "technologically achievable" conditions. In proposing the standard with respect to vinyl chloride, the Secretary has not taken into consideration the overwhelming engineering and technological data which decisively establishes that the proposed exposure levels are not attainable through engineering controls and work practice methods. The standard is simply incapable of being implemented by such means. Rather, the effect of the proposed standard will result in the very consequences Congress intended to avoid--putting employers

out of business. The comments of the Court in I.U.D. v. Hodgson, supra, with respect to Senator Javits' observations, are indeed applicable here (at p. 1639):

> "Congress does not appear to have intended to protect employees by putting their employers out of business--either by requiring protective devices unavailable under existing technology or by making financial viability generally impossible."

C. Engineering and Technical Obstacles Prevent Immediate Reduction of Measurable Concentration of Vinyl Chloride in the Ambient Air Below 50 PPM; Further Graduated Reductions Can Be Achieved Only Through Extensive Capital Equipment Replacement Programs

Although the majority of the PVC industry is capable of operating under the temporary emergency standard, the industry will not generally be able to function under exposure levels below 50 ppm without making extensive and costly expenditures for new equipment and engineering changes over an extended period of time. The technological studies instituted by Firestone sought to determine the equipment and design changes and plant modifications which would be required in order to achieve exposure levels below the 50 ppm specified in the temporary standard. The studies attempted to determine what equipment and design changes would have to be made at Firestone's plants to achieve exposure levels of (a) less than 50 ppm, (b) 25 ppm TWA with a 40 ppm ceiling, (c) a level of 10 ppm TWA with a 15 ppm ceiling, and (4) the non-detectable level required by the proposed permanent standard.

Merely to meet, on a continuing basis, the 50 ppm exposure level while reducing the TWA exposure of the temporary emergency standard at Firestone's Pottstown facility, capital equipment changes costing in excess of $5,000,000 would have to be made.[94/] Changes in work practices at Pottstown, as dictated by the work practice rules alone of the proposed standard, would require the expenditure of more than $1,000,000 for items such as the respiratory equipment, including face masks, back packs, demand regulators and special clothing. New engineering controls, costing millions of dollars and including such items as purge systems for vinyl chloride unloading lines, portable units for airing out storage vessels, improvements to the plastisol stripping process, installation of permanent air systems to supply breathable air to the plant, equipment to provide reactors and strippers negative air pressure during cleaning operations, and improvements to and installation of new ventilation equipment in various plant areas would have to be made. Other structural changes would have to be made to enclose break areas and to expand lunchrooms and to provide shower areas.[95/]

At Perryville, the changes required merely to comply with the proposed standard but at a 50 ppm ceiling level, would cost $1,771,000.[96/] The Perryville engineering report

---

94/ The Catalytic, Inc. study indicates that the cost of these improvements would actually approximate $7,000,000.

95/ Pottstown Engineering Study, Appendix pp. 59-62.

96/ The Catalytic, Inc. study indicates this amount to be $2,145,000.

lists the new and additional equipment that would be required and includes among the more costly items equipment to provide stack vents and other lines to the surge tank and recovery system, additional recovery capacity for purging reactors and a continuous monitoring system.

Much of the new equipment and engineering controls which would have to be installed merely to provide a capability of meeting a 50 ppm maximum exposure level at both plants cannot be acquired and placed in operation in less than one year. Indeed, delivery and installation of equipment for the Pottstown plant, and which would be necessary to incinerate dryer stack gases to reduce the discharge of vinyl chloride to the outside air, if at all operable, would take two years. 97/

As the exposure level objective is reduced, the magnitude of the expenditures required in attempting achievement of those lower levels increases dramatically. As indicated by the Pottstown engineering study, achievement of a 25 ppm TWA and 40 ppm ceiling level consistent with engineering controls and work practices would require an additional capital investment for equipment and engineering control changes amounting to $10,893,000. The Catalytic, Inc. study indicates that these costs actually would amount to $14,800,000. In addition to providing the equipment and controls necessary to achieve a 50 ppm exposure level,

---

97/ Pottstown Engineering Study, Appendix p. 61.

major engineering changes would have to be accomplished in order to reach the 25 ppm TWA-40 ppm ceiling objective.

A major portion of the additional equipment that would have to be added to the Pottstown facility would be required in the polymerization buildings and spray dryer areas. For example, stripping capacity would have to be increased to 8 strippers which would take two and one-half years to accomplish because of the lead time necessary to obtain delivery of the equipment after it has been ordered from the manufacturer. Provisions for incinerating all emissions from both polymerization buildings, ducting all building ventilation to points remote from the plant and attempting to provide means for incinerating dryer stack gases through three 200,000 cfm dryers would take 2 to 3 years to accomplish because of severe equipment shortages and the time required to design and fabricate such equipment. Additional and costly ventilation equipment would also be required.

At Perryville, an additional $2,274,600 would have to be spent to reach the 25 ppm TWA-40 ceiling or as determined by Catalytic, Inc., $2,953,000. A carbon absorption system, yet to be commercially proven, with surging provisions would have to be installed, along with other less costly items, in addition to all of the equipment required to enable the Perryville plant to achieve the 50 ppm level. In addition, changes and additions to the new plant being built at Perryville would cost another $2,450,000 to try and enable that facility to meet the desired lower exposure level.

Substantially more equipment at practically double the cost would be required to try and achieve a workable, continuing exposure of 10 ppm TWA with a 15 ppm ceiling. The Pottstown engineering study indicates that it would cost between $27,505,000 (Firestone estimate) and $29,150,000 (Catalytic, Inc. estimate) to modify the Pottstown facility attempting to achieve these lower exposure levels. However, even if these capital expenditures were made and the complex equipment and engineering controls added to the Pottstown plant, no assurance can be given that these exposure level objectives could be attained. Thus, the report states:

> "We believe these levels could be complied with based on present engineering expertise and current technology. There would be certain areas within the plant where masks are never necessary, but most would still fall into a 'Regulated Area' classification based on the definition given in the standard." (Appendix p. 52)

The report also notes that current technology is inadequate, in light of the desired level, to overcome problems with stripping of suspension and plastisol resins to minimal residuarl monomer levels.

Dr. Higgins concluded with respect to the possibility of meeting a 10 ppm TWA level:

> "A level of 10 ppm on a time-weighted average basis might ultimately be achievable in existing polyvinyl chloride plants through construction of extensive and costly new ventilating collecting and exhausting systems, particularly in high concentration areas and through revised

> handling methods in transfer areas. However, on the basis of present technology, no definite forecasts can be made as to whether this low level can be attained. Whether such a low level is practical and achievable can be determined only after the new equipment and engineering procedures have been installed."

Among the more costly equipment which would have to be installed at the Pottstown facility with the objective being to reach a 10 ppm TWA-15 ppm ceiling exposure level are twelve strippers, costing $2,000,000, to double stripping capacity and which would take 2 to 5 years to install; the replacement of all existing blend tanks with pressure rated vessels--full vacuum to 100 psig--with necessary controls at a cost of $4,200,000 and which would require 3 to 4 years to install; replacement of all existing compressors with Nash rotary compressors, totally enclosing the floc removal systems, sealing off all pot strainers, screen areas with necessary ventilators, installation of a permanent air system for the plant, provisions for incinerating all emissions from both polymerization buildings, provisions for incinerating dryer exhausts, installation of a scrap incinerator and numerous other capital equipment changes as listed in the report. (Appendix pp. 48-52)

To achieve similar exposure reductions at Perryville the cost estimates range from $3,530,900 (Firestone estimate) to $6,675,000 (Catalytic, Inc. estimate). Included among the additional equipment and engineering changes needed to try to reach the 10 ppm TWA-15 ppm ceiling level, would be the seal-

ing of purge blend tanks and filters with carbon absorption and means for flushing the tanks remotely, the addition of two strippers in a 20 x 40 building plus additions for steam flow and the installation of a 1000-pound per day PVC incinerator. The new Perryville expansion unit would require from $2,197,000 to $2,568,000 in additional equipment or engineering changes to reach this level of exposure.

As noted earlier, the costs of attempting to reach the non-detectable levels required by the proposed permanent standard at Firestone's two facilities are prohibitive--more than double Firestone's present investment. Dr. Higgins stated in his conclusions, "achievement of non-detectable levels of vinyl chloride is virtually impossible without, in effect, rebuilding the plant." The engineering reports from Pottstown and Perryville specify the extensive and complex engineering changes and equipment additions which would be required just trying to achieve such an impractical and unrealistic exposure level. (Appendix pp. 42-46, 88-89) The total amount of these capital requirements, ranging from $47,585,000 (Firestone's estimate) to $55,609,000 (Catalytic, Inc. estimate) in view of the improbability of ever achieving the specified non-detectable level and the drastic effects on production (52.6% loss at Pottstown; 10-25% at Perryville), it is glaringly apparent that the proposed standard is grossly not feasible.

The Secretary, in proposing the permanent standard, has apparently also overlooked the enormous additional operating

costs that would confront the industry from adoption of the vinyl chloride standard as well as the grave impact the standard will have on domestic energy reserves. On August 31, 1973, Catalytic Construction Company completed an engineering study of an incinerating system to handle hydrocarbon discharges from the spray dryers at the Pottstown plant. On the basis of this study, the additional operating costs for incineration alone at Pottstown, if operable and effective, would be between 1.5 and 2 million dollars per year. Fuel oil requirements to operate the system would be from 4 to 5 million gallons per year. In addition, approximately 5 million kilowatt hours of electrical power per year would be consumed. (Appendix p. 39)

Additional ventilation installations for most plants will also greatly increase steam consumption for heating purposes. At Pottstown, steam consumption would double requiring an additional 0.5 to 1.0 million gallons of oil each year. The ventilation equipment, as well as new process and air supply equipment would increase electrical power consumption in the range of from 15 to 20 million kilowatt hours in excess of the additional electrical power requirements for incineration purposes. (Appendix, p.40)

The energy impact at Perryville is equally significant in attempting to achieve the non-detectable levels required by the proposed standard. Oil requirements would be increased over existing consumption 119% and electrical power requirements

by more than 37%. Total operating costs would be proportionately increased. (Appendix, p.112)

Clearly, the energy impact and additional operating costs which would be imposed upon the polyvinyl chloride industry is predicted by the effects the proposed standard would have on those items at the Firestone plants. The consequence throughout the industry unquestionably would be of monumental proportions.

The engineering studies carried out at Firestone could essentially reflect the magnitude the proposed permanent standard will have on the other domestic PVC facilities. The capital expenditure requirements as well as implementation of the stringent work practice rules will result in economic havoc which would not be sustained by even the largest companies in the industry. The severe impact on employee morale and resulting turnover would make it unrealistic and illogical for PVC manufacturers to attempt to continue operating. The drastic loss of employment and the overall effect on the economy refutes the feasibility of the proposed standard when viewed in light of the requirement that exposure levels be accomplished solely through engineering controls and work practice methods.

Firestone has greatly accelerated its efforts to provide engineering and technological improvements designed to

assure the health and safety of all employees engaged in vinyl chloride operations. Firestone will continue its efforts to achieve further profound reductions in exposure levels to the end that all who work with vinyl chloride can be confident that no health hazard exists by virtue of their employment. Firestone and the industry should be permitted to continue their efforts to achieve meaningful and realistic health goals without being confronted by an unrealistic and technologically unachievable standard.

Also, in this context, it is impossible to see how observers can record quantities and results "without interference to the persons performing the monitoring and measuring" as provided for in section (e)(3)(B)(iii), especially if a significant number of quantities and results are being obtained and a large number of observers are present. While employees have a legitimate right to know what the monitoring is revealing, this right can more appropriately be fulfilled by requiring that the results of the monitoring be readily available for inspection.

5. Respiratory Protection. The use of respirators as required in (f)(ii) and (iii); (g)(2); (1) (4) (i) and (m) (3) of the proposed standard may constitute a safe work practice and adequately protect employees when exposure levels reach extremely high concentrations. However, the four types of respirators specified in (g)(3) and the need to wear such respirators when low levels of VCM are present, except when employees are cleaning reactors as more fully explained in Section VII below, is not necessary and in fact decreases the safety of affected employees for the reasons set out below.

Because the entire plant complex is periodically or continually exposed to detectable levels of VCM, the proposed standard, in effect, requires that respiratory protection be provided for and used by every employee in the entire complex. The four types of respirators specified in (g)(3)

all require the utilization of a full face-piece providing for a positive pressure or operating in a pressure demand mode. Such masks are extremely uncomfortable and burdensome to employees, and could therefore cause a decrease in employee efficiency.

Additionally, the wearing of such masks would constitute a safety hazard in and of itself. Operators and maintenance personnel wearing full face masks and carrying an air bottle or trailing air hose cannot provide the alert surveillance needed to avoid accidents. Faulty maintenance is almost certain to occur because the craftsman cannot see clearly or would be so preoccupied with the mask as to lose concentration on the job. Operators must be able to read clearly the instruments describing the state of the reaction in the reacting vessels. They must be alert for upset or dangerous conditions shown. They must concentrate on the job at hand. Placing employees in a full face-piece, air-supplied respirator will diminish their alertness and concentration resulting in poor work and frequent mistakes.

Furthermore, use of an air-supplied respirator would greatly restrain an employee's mobility. Each time an employee finds it necessary to move a distance of more than 50 feet from his work station he may be required to switch from an air supply system to a portable back pack

unit. Under these types of restrictions personnel hygiene requirements become almost impossible. In the course of performing the requirements of various jobs in the plant, employees must move rather extensively around the equipment, between floors, up and down stairs and distances of 30 to 50 feet from a central station. Such requirements for mobility make permanent air stations and hoses totally impractical. As a possible alternative the employees may be supplied with a portable back pack air supply unit, such as the MSA Model 401 Portable Breathing Apparatus. This unit weighs approximately 28 pounds and provides an air supply of about 30 minutes. Assuming an adequate safety factor of 10 minutes, an employee would have to change three times per hour or perhaps use units with larger air supplies weighing up to 50 or 60 lbs.

Moreover, changing of tanks would also impede mobility because in changing tanks the employee would have to be in an area containing undetectable levels of VCM. This would require an employee to leave his work area unattended, a safety hazard in and of itself, in order to effect a tank change. Tank change areas would have to be specially built and be securely isolated from the work area in order to guarantee non-contamination. Due to these various factors and inconveniences, Firestone's operating personnel have estimated that approximately 25 percent of the present employee staff may either terminate employment or request transfers to different

areas if required to wear such respirators during a major portion of their working day.

Firestone submits that the use of air-supplied respirators is only necessary when concentrations of VCM reach excessively high levels and that when such incidents do occur, full-face masks are not necessary and are in fact dangerous to employeee safety for the reasons given above, particularly in view of the fact that all employees in the PVC plant will be required to wear these devices if the standard is set at 0-1 ppm detectable level. Respirators which are less cumbersome and provide the employee a greater degree of visibility, mobility and comfort, such as canister type respirators, should be required, however, for use whenever employees clean reactors.

6. Protective Clothing. Section (h)(1) requires that employees entering a regulated area shall wear protective full-body clothing, footwear and gloves. Protective clothing is defined in (b)(13) to be clothing protective against VCM. To be "protective against VCM," such clothing would have to be impervious to air due to the fact that VCM is a gas. As a consequence, such clothing would also be impervious to body moisture, resistant to heat passage, and would tend to be extremely abrasive to the skin. In effect, therefore, although the proposed permanent standard makes a distinction between "protective" and "impervious" clothing (compare sections H and 1(4)), the distinction made is without a

ment to wear an air respirator is unnecessary, burdensome and unsafe for the reasons stated above (pp. 109-112). Furthermore, enforcement of employee compliance will be difficult.

13. Reports. Due to the fact that leaks of VCM may occur frequently, there is almost continuous employee exposure to small level concentrations of VCM. Each exposure, no matter how brief or small, would necessitate the filing of a written report. Consequently, the employer who provides the best monitoring system will have the most violations and be required to file the most reports. This will motivate employers to do as little monitoring as possible and will discourage the installation of fixed, continuous monitoring systems.

E. Economic Impact Of The Proposed Work Standard Rules On Employee Productivity And the Need For Additional Personnel In Firestone's Facilities

Pottstown. In the attached report (Appendix 47), the Pottstown facility has estimated that because of the proposed work practice rules, it is doubtful that the current work force could maintain present production levels, and an immediate 33% increase in manpower would be necessary to maintain those levels. Further increases in production manpower would have little effect on output because overcrowding

conditions would develop.

The impact of the proposed work practice rules on manpower increases for other affected job classifications has been estimated in the above-mentioned report as follows:

Maintenance manpower (due to work practices and increased physical plant)	400% Increase
Supervision	50% Increase
Engineering and Technical	100% Increase
Clerical and Secretarial	200% Increase
Laboratory personnel	50% Increase
Janitorial (24 hour basis)	200% Increase

In addition, the economic expenditures for modification and purchase of equipment which will be necessary to comply with the proposed work rules and the time to install such equipment, has been estimated in the above-mentioned report for each regulated area to be as follows:

TANK FARM - REGULATED AREA	Capital Cost (In Thousands)	Time to Install 101/
1. Back pack unit and protective clothing for pipefitters and hooking up vinyl cars for unloading (3)	2.2	10 Wks.
2. Full face mask, demand regulator, hose and back pack for tank farm operator, tank farm relief man and centrifuge man at waste treatment. Protective clothing for these men (7)	5.6	10 Wks.

101/Time from Project Approval to installation.

	Capital Cost (In Thousands)	Time to Install
3. Back pack unit and protective clothing for rubber lab sample man (3)	2.1	10 Wks.
4. Back pack units for bulk delivery drivers, dumpster operators and railroad personnel (8)	6.4	10 Wks.
	$16.3	

POLYMERIZATION BUILDINGS REGULATED AREA

1. Full face mask demand regulator, hose, back pack and protective clothing for reactor operators, relief operators, area fitters, utility & service, lab sample men and foremen (67)	53.0	10 Wks.
2. Air tight containers for removing scrap from buildings	15.0	24 Wks.
	$68.0	

BULK AREA - REGULATED AREA

1. Full face mask, demand regulator, hose, back pack unit, protective clothing for centrifuge men, baggers, utility & service and foremen (21)	16.8	10 Wks.
2. Three portable air systems for truckers	4.5	10 Wks.
3. Back pack unit for outside truckers (3)	1.3	10 Wks.
4. Air tight containers for overflow to replace tote bins and drums	100.0	48 Wks.
	$122.6	

	Capital Cost (In Thousands)	Time To Install
WAREHOUSE AND GENERAL PLANT - REGULATED AREA		
1. Portable air system for truckers (6)	$9.0	10 Wks.
2. Full facemask, demand regulator, hose back pack and protective clothing for warehouse utility and foremen (9)	7.2	10 Wks.
3. Full face mask, demand regulator, hose, back pack and protective clothing for maintenance men (50)	40.0	10 Wks.
4. Full face mask, demand regulator, hose back pack, and protective clothing for office and lab personnel (100)	80.0	10 Wks.
	$136.2	

Perryville. In the attached report (Appendix 108), the Perryville facility has estimated that implementation of the proposed work rules would reduce productivity by approximately 10 to 25 percent.

It is also estimated in the above-mentioned report that the proposed work rules would require additional personnel in the following job classifications: 102/

102/ For a further breakdown of the specific job assignments for these employees, see the attached report (Appendix 95-97).

Line Production Supervision	1
Salary Office Staff	11.5
Maintenance Supervision	1
Maintenance (hourly)	9
TOTAL	22.5

Conclusion

Entirely aside from the appropriate level of VCM exposure, the work practices in the proposed permanent standard will require Firestone to cease its PVC operations entirely. As shown above, not only are the work standards infeasible from an operational standpoint, but also many have no safety or health benefit and some are, in fact, potentially hazardous.

VIII. THE PROPOSED PERMANENT STANDARD IS NOT ECONOMICALLY FEASIBLE

A. The Work Standards Are Counter-Productive

The economic impact of the proposed permanent standard will be felt at all levels of the PVC industry.[103/]

The capital investment necessary to meet the proposed permanent standard is staggering, if not prohibitive. For example, even were it possible to meet a non-detectable standard, it would be necessary to more than double the industry's present investment. In dollar terms, Firestone's engineering studies, conformed by studies conducted by Catalytic, Inc., reveal that it will cost $9,638,000 to modify Firestone's plants merely to comply with a 50 ppm standard.[104/] Modification costs will rise to $20,203,000 to comply with a 25 ppm TWA-40 ppm ceiling standard and to $39,393,000 to comply with a 10 ppm TWA-15 ppm ceiling standard. Even if compliance with a non-detectable standard were feasible, modification costs would be $55,609,000, thereby increasing Firestone's present total capital investment from $49,682,000 to $105,291,000.

103/ The following economic data is derived from the Firestone experience. Although adjustments would have to be made for age, production methods, and product mix, the figures are, nevertheless, representative of the industry average.

104/ The estimated costs of the capital improvements and engineering changes at Firestone's plants have been determined on the basis that full compliance with and implementation of the engineering controls and work practice methods specified in the proposed permanent standard will be required regardless of the exposure level ultimately selected. For a detailed breakdown of the capital costs, see Appendix pp. 131-34.

The is little doubt that the age of a PVC plant and its production methods will significantly effect the costs of modifying that particular facility. Firestone, for example, has two plants with comparable volumes. One plant is si[illegible]ears old and utilizes only a suspension polymerization/rotary drying operation. It is estimated that modification costs would be 19% above current capital investment for compliance with a 50 ppm standard; 25% for compliance with a 25 ppm TWA-40 ppm ceiling standard; 63% for compliance with a 10 ppm TWA-15 ppm ceiling standard; and, 174% for compliance with a non-detectable standard. By comparison, Firestone's second plant is over twenty-five years old and has been well maintained and regularly modernized. This plant utilizes both suspension and emulsion polymerization techniques. The modification costs for this latter plant are significantly higher than the costs to modify a new facility. Thus, to comply with a 50 ppm standard it would be necessary to increase current capital investment by 60%. This figure would rise to 116% if a 25 ppm TWA-40 ppm ceiling standard is required. If a 10 ppm TWA-15 ppm ceiling standard is used, the capital cost increase is 245%. If a non-detectable standard is used, the capital cost increase for the older facility reaches 387%. Clearly, newer plants

will enjoy a material competitive advantage. The probability that older plants will elect to cease production of PVC cannot be ignored.

Despite the tremendous modification costs required to meet the alternative standards, productivity will decline sharply. For over a year and a half Firestone has been operating at full capacity to meet the ever increasing demand for PVC. Firestone's experience is indicative of the entire industry. With the implementation of the proposed permanent standard, the industry capacity would be substantially decreased, thereby exacerbating the domestic supply shortage.

Firestone currently has a capacity of 507 million pounds PVC. Under a 50 ppm standard, this capacity would drop to 459 million pounds. The drop would be even greater, i.e., to 447 million pounds, if a 25 ppm TWA-40 ppm ceiling standard were utilized. Under a 10 ppm TWA-15 ppm ceiling standard, capacity would decrease to 420 million pounds. Even were it possible to comply, Firestone's capacity would drop to only 353 million pounds under a non-detectable standard.

The economic impact on the industry's manpower will be significant when the increases in manpower required by the reduction of employee efficiency as a result of the

work standards and the increased supervision and staff personnel necessary to insure compliance with these standards are factored in.[105/]

Firestone has estimated that it would need to increase its manpower by 249 or an increase of 57% to comply with a 50 ppm standard. Compliance with a 25 ppm TWA-40 ppm ceiling standard would require an increase in manpower of 275 or a 63% increase. These figures would rise to a 437 or 100% manpower increase if a 10 ppm TWA 15 ppm ceiling is utilized. If a non-detectable standard is required then there would have to be a 492 or 113% manpower increase even assuming Firestone could operate under such a standard.

Such proposed requirements as the use of impervious clothing, mandatory hygiene practices, medical testing and surveillance, and personnel monitoring will substantially reduce worker efficiency. The impervious clothing and the even more elaborate "space suits" will not only hamper the worker's movements but will also induce fatigue, thereby necessitating additional rest periods. Thus, even absent an increase in wages and benefits, the costs resulting from the increase in sheer numbers of employees are prohibitive for most if not all the current PVC manufacturers. Of course, the cost of increased manpower is meaningless if the supply is unavailable. Certainly the stringent and unappealing

---

105/ For a detailed breakdown of the increases in manpower necessitated by the various suggested standards, see Appendix pp. 47, 53, 62, 90-97.

:k standards will discourage new applicants and most proba-
:y induce a loss in present personnel. Higher wages and increased benefits might provide an incentive to keep existing employees and attract new applicants, but the added costs from wage and benefit increases would only exacerbate the problem of the extreme and detrimental economic impact wrought by the proposed permanent standard.

With the drastic increases in capital costs, manpower, wages and benefits and the concomitant decrease in capacity and productivity, Firestone has estimated that prices would have to increase over 50% to balance the additional costs from the proposed permanent standard. The higher capital risk would also reflect in the price, as would the increased capital cost per pound. The potential economic impact on the price for the 4.8 billion pound domestic PVC industry could exceed $1 billion annually. More specifically, Firestone has determined that under a 50 ppm standard, the price of PVC would rise by 15%. Under a 25 ppm TWA-40 ppm ceiling standard, the price would rise by 20%. This price increase would jump to 33% if a 10 ppm TWA 15 ppm ceiling is utilized. If the industry were able to operate under a non-detectable standard, the price would increase by 55%.

B. The Proposed Permanent Standard Will Have Deleterious Effects On Industry Structure and Domestic Competition

The results of the proposed permanent standard will not affect equally all domestic PVC producers.

It was demonstrated in Section A above that the age of a plant will significantly affect modification costs. Thus, producers with newer plants will have a substantial competitive advantage. They may, in fact, be the only producers of PVC capable of surviving the implementation of the proposed permanent standard.[106/]

Another factor which accords some producers a significant competitive advantage is the location of their plants. There are in the southwestern United States some PVC plants that are in the open air. The lack of an enclosing structure materially alleviates VCM concentration, thus facilitating compliance with a lower standard.

With the implementation of the proposed permanent standard, a serious threat of monopoly presents itself. Those producers with newer plants or plants located out-of-doors will have so great a competitive advantage that it will be economically unfeasible for other PVC producers to even attempt to compete with them. The result will be the survival of only a few producers and the creation of a monopolistic industry.

106/ See Appendix p. 36-38.

The deleterious effects of the proposed permanent standard will not be restricted to the PVC industry alone. One study has concluded that an instantaneous shutdown of the PVC industry will create a snowball effect potentially dragging down with it or, at best, seriously disrupting, such industries as the building and construction industry, the automotive industry, the apparel industry, the specialty products industry, and miscellaneous other industries which significantly rely upon PVC.[107/] Preliminary calculations indicate staggering losses in money and jobs for these collateral industries. It is estimated that the construction industry will lose between $14 to $20 billion annually and between 500,000 to 800,000 jobs should there be an instantaneous shutdown of the PVC industry. The automotive industry could lose from $35 to $50 billion annually and 600,000 to 1,000,000 jobs. The apparel industry risks a loss of $2.5 to $3.5 billion annually and 100,000 jobs. The specialty products industry could lose $8 to $10 billion dollars and 300,000 to 400,000 jobs. The miscellaneous industries risk a loss of $5 to $6 billion dollars annually and 100,000 to 300,000 jobs. These are hardly negligible figures. Moreover, it is estimated that it would take at least two to three years to develop substitutes for the PVC now utilized so extensively by these industries.

C. The Effects of the Proposed Permanent Standard on Foreign Competition

The total disruption of the domestic PVC industry must engender international ramifications.

107/ Arthur D. Little Co. Preliminary Report on Vinyl Chloride Industry.

With the curtailment of the domestic PVC industry, [illegible] producers, unfettered by the restrictive standards [illegible]ed in the United States, will, by necessity, take over [illegible]omestic market. Fabricators who rely upon PVC exten[illegible]ly would probably be unable to comply with the standard. [illegible]n were compliance possible, they would be faced with a [illegible]lemma. They might import their PVC, but this would re[illegible]uire a drastic increase in the price of their finished product. Foreign fabricators, unhampered by the cost of importing their PVC, would price their American counterparts right out of their respective end-product market.[108/] An alternative for the American fabricators is to move their domestic operations abroad. This action would only exacerbate the United States' economic problems. Undoubtedly, either alternative will have a detrimental effect upon the United States' balance of payments.

Another effect on foreign competition wrought by the implementation of the proposed permanent standard will be to accord those domestic producers with extensive foreign operations a substantial competitive advantage.[109/] B. F. Goodrich, for example, has interests of 100% or less in foreign operations with a combined PVC annual capacity of 783 million pounds.

108/ Of course, domestic fabricators may be unable to obtain PVC from foreign sources when the supply becomes tight due to the curtailment of American production.

109/ See, II, Section B, supra, for discussion of foreign PVC production and American corporate interests therein.

Without the extreme restrictions imposed by the proposed permanent standard, the foreign PVC producers will be unrivaled in PVC production. While those domestic producers who are able to survive are retooling to comply with the proposed permanent standard, foreign producers will be expanding their operations.[109a/] It may be impossible for domestic PVC production to ever catch up. The capacity of foreign PVC production will increase as United States capacity decreases. Concomitantly, the price of foreign PVC will decrease as the price of domestic PVC increases.

The proposed permanent standard has, therefore, the potential for such extreme economic dislocation as to be economically unfeasible.

109a/ Indeed Great Britain has recently adopted a ceiling of 50 ppm with a 25 ppm TWA exposure level. See Appendix pp. 217-222.

IX. CONCLUSION: FIRESTONE'S PROPOSAL FOR A PERMANENT STANDARD REGULATING OCCUPATIONAL EXPOSURE TO VINYL CHLORIDE

A. Introduction

Firestone's management is gravely concerned about the potential health hazard which may result from indiscriminate and uncontrolled exposure to VCM. The Company believes, however, that present medical and scientific data does not justify the abrupt termination of an industry affecting hundreds of thousands of people. Firestone's position with respect to this matter was not reached without profound study and concern about the health aspects which may result from undue exposure to VCM. As a result of the Company's intensive review and study of the medical problems that potentially exist and the severe economic impact on the industry, the Company has concluded that prudent and careful management of all VCM operations are required and that every technologically feasible method that can be employed to protect the people involved in the industry must be adopted. Because the proposed levels are technologically unachievable and economically unsound, a reasonable and medically prudent exposure level must be selected with the intent of providing sufficient protection to the health and safety of all engaged in the industry. A reasonably achievable and feasible exposure level, in conjunction with safe and practical work practice rules should be adopted with, of course, the overriding

consideration being the attainment of the most limited exposures of VCM to industry employees.

Firestone believes that a safe and medically sound, as well as a technologically and economically feasible standard, is that which provides for a 25 ppm TWA and 40 ppm ceiling exposure level. Close and careful adherence to this level with appropriate and adequate work rules will assure safe working conditions without destroying the entire industry. These levels, if properly implemented and enforced, will minimize occupational risks and the complex medical problems involved and afford industry and the engineering community opportunities to develop more sophisticated and advanced techniques which can be employed further to reduce vinyl chloride levels in the ambient air.

The exposure level standard which Firestone proposes, 25 ppm TWA coupled with a 40 ppm ceiling, is not one which is immediately achievable nor a level which can be accomplished without the expenditure of millions of dollars at Firestone alone. However, it is technologically achievable and although one which will have severe economic consequences on the PVC industry, is a level under which the industry can economically survive. This exposure level should be maintained as the permanent standard until further ongoing medical experimentation and study, of the human as well as animal experience, is

completed and more definitive conclusions have been reached concerning the nature and consequences VCM may have on industry employees.

Finally, Firestone is willing to expend all capital necessary for the research, development and implementation of those procedures which will reduce employee exposure to VCM to the lowest technologically feasible level.

Therefore, Firestone is submitting a proposed standard which will provide industry employees a medically prudent and healthful working environment and one which is engineeringly and economically feasible. The text of the proposed standard is attached hereto as Appendix 1-28. The following is an analysis highlighting the major sections of the Firestone proposed standard.

B. Exposure Limitations: Time Weighted Average (TWA) and Ceiling Values

The two basic methods of monitoring airborne substances for compliance with established concentration exposure levels are ceiling value concentration levels and time weighted average (TWA) value concentration levels.

The ceiling value limitation method, which was adopted by the Secretary in promulgating the emergency temporary

ard on VCM[110/] and which is proposed in the permanent ard, represents the maximum exposure concentration allowed ny given time. Pursuant to universally accepted chemical industrial hygiene practice, this limitation is actually lied only to those toxic substances which are fast acting and capable of producing acute toxic reactions, such as hydrogen sulfide or acetic anhydride. Any exposure to these substances above the ceiling value may cause intolerable irritation, chronic or irreversible tissue change, or narcosis, and as a consequence strict enforcement of the ceiling value limitation is necessary.. (Appendix p. 144)

The TWA method for monitoring exposure is based on the average exposure experienced over a specified length of time, which is usually an eight-hour period, with upper limits of excursion permissible above the TWA value. Under universally accepted chemical and industrial hygiene practice, substances which do not produce immediate or acute toxic reactions are monitored on a TWA basis. (Appendix p. 144)

Conequently, because several investigators have shown that acute poisoning is virtually impossible from VCM exposure[111/] and because the only immediately lethal danger from VCM is at exposure levels where VCM has anesthetic

---

110/ 39 Fed.Reg. 12342 (1974).

111/ Documentation of the threshold limit values, American Conference of Governmental Industrial Hygienists, 3d Ed. (1971), p. 277.

properties, Firestone submits that adoption of a TWA value for VCM exposure is appropriate. Moreover, TWA measurement for VCM exposure is also appropriate because the human body tends to act as an averaging device when exposed to VCM.[112/] Thus, it can be shown that a short exposure to levels higher than the TWA will have little effect on the total exposure received by the human body. (See Appendix 144)

Furthermore, because the gaseous nature of VCM causes it to exert a pressure in the range of 40 psig at normal temperatures and of 100 to 150 psig at reaction temperatures, some leakage of VCM is unavoidable in PVC plants. When such leakage does occur, a fairly high concentration of VCM will exist within the immediate area of the leak, but only for a short period of time because the vapor almost instantaneously dissipates into the atmosphere, and, in Firestone's plants, is removed from the atmosphere by exhaust fans which are capable of changing the air within the plants every three to six minutes.

C. Work Practice Rules

Appendix 1-15contains the text of Firestone's proposal with respect to work practices and medical surveillance, which not only provide for employee health and safety but which also are technologically and economically feasible. The following summarizes the major provisions of Firestone's proposal.

112/ Henderson, Haggard, Noxious Gases and the Principles of Respirators Influencing Their Actions, Reinhold Publishing Co., New York, New York (1943)

Firestone Plastics Company

DIVISION OF THE FIRESTONE TIRE & RUBBER COMPANY

HARVEY S. FIRESTONE · FOUNDER

CHEMICALS DIVISION
P. O. BOX 699
POTTSTOWN, PENNSYLVANIA 19464

POTTSTOWN, PENNSYLVANIA
May 24, 1974

THE PROPOSED OSHA STANDARD FOR VINYL CHLORIDE

The comments that follow relate primarily to the Pottstown, Pennsylvania, Chemical Plant and how the proposed OSHA regulations will affect the operations of this facility. Certainly most of them can be extrapolated to any other PVC producing plant; however, some of them will be specific to only this single facility because of its age, location and diverse product line. The Pottstown plant produces products in five (5) major categories (plastisol, suspension PVC resins, suspension copolymer resins, solution grade resins and styrene butadiene latex) which we subdivide into thirty-six (36) specific product lines, each of which has different physical/chemical properties. All of these products are produced in reactors (autoclaves) that are basically quite similar; however, the support equipment upstream and downstream of the reactors differs markedly. Excluding minor equipment differences and polymer composition, there are four (4) significantly differing process lines. The discussion that follows will relate primarily to the production of homopolymer/copolymer and plastisol (dispersion resin).

I. PLANT DESCRIPTION--PROCESS DIFFERENCES

The physical complex consists of sixty-five (65) total reactors, sixty-one (61) of which are in vinyl chloride service. The reactors are housed in two poly buildings, one containing twenty-three (23) reactors, the other forty-two (42). At any given time we are producing seven (7) different vinyl chloride containing products. Four (4) of these are suspension types and three (3) are plastisol types.

A. SUSPENSION TYPES

The suspension types are characterized by their relatively coarse particle size with average particle diameter in the range of 100 microns to 180 microns. They require intensive agitation and baffling and contain low levels of suspending agents or other impurities. The physical form ranges from extremely dense glassy type particles to fluffy porous particles. Residual monomer content in the finished resin depends primarily on the porosity or density of the particles with the more dense less porous particles containing much more residual monomer. Vessel cleanliness is of extreme importance in producing suspension resin in that dirty or built-up vessels are directly related to the production of inferior unmarketable product.

B. PLASTISOL TYPES

These products are produced as dispersions of extremely small PVC particles in an aqueous medium which are subsequently dried and sold as a powder for end-use applications. The latex particles average 1-2 microns in diameter though the dried powder is somewhat more coarse. These systems contain relatively high levels of emulsifiers and other impurities; however, they are extremly unstable in the latex form. Excessive agitation or shear leads to floculation/agglomeration and the production of unusable product. Because of its extremely small particle size, this material is dried in spray dryers similar to equipment that can be used in producing instant coffee or dried milk. The instability of the latex makes removal of unreacted vinyl chloride monomer extremely difficult. Residual monomer content prior to drying may range seven to ten times higher than that encountered in most suspension resin products.

Firestone has been intensively investigating improved equipment and procedures for reducing these residual monomer levels during the past two years without significant success. Because of the small particle size and drying techniques however, the finished dried powder contains generally less than 10 ppm residual vinyl chloride (weight per weight). Removal of any excessively large particles from the latex is an absolute necessity from a product quality standpoint. Because of the generally poorer stripping efficiency and the large dense nature of these particles, residual monomer content is quite high at this point. The magnitude of exposure problems is many times greater than those encountered in suspension PVC production. Reactor cleanliness is not especially important to product quality; however, it has a great deleterious effect on heat transfer. For this reason, residual material must be flushed from the vessel walls after each batch.

II. STANDARD COMPARISON--TWA AND CEILING

Because vinyl chloride is an extremely volatile gas at room temperature, standards based on ceiling exposure are especially difficult to implement. In a well ventilated area local high concentrations of vinyl chloride can be rapidly diluted within the space of a few feet and several seconds. This phenomenon results in the situation wherein an employee can be exposed to small pockets of high vinyl chloride concentration while moving about the plant area. In order to assure compliance to any ceiling standard, instantaneous continuous portable monitoring equipment must be available. The OSHA method of collecting ten minute samples for determining ceiling exposures must thus be considered as actually being a time weighted average sample based on a short time period. In addition, this type of standard or sampling procedure cannot protect an employee from exposure to a small pocket of high vinyl chloride concentration in a localized area existing a few feet from the paths he traveled while being monitored. Since there is no commercial equipment available to continuously monitor or protect employees from unknowingly entering areas high in vinyl chloride level, it would appear that only a standard based on TWA can provide adequate protection to employees and information concerning their real exposure.

II. STANDARD COMPARISON--TWA AND CEILING (Continued)

Since late March 1974, Firestone has been involved in an intensive personnel monitoring program entailing the gathering and analysis of approximately sixty (60) ten minute samples each day. At the same time, many instantaneous checks for total hydrocarbon concentration were made using a Century Portable Organic Vapor Analyzer. Correlation of the two different tests was extremely difficult and we believed this was due to the large quantities of co-monomers being used. More recent information indicates that much of the variation in test results (both in the personnel monitoring and in the Century readings) is due to extremely small, very difficult to detect leaks. These small leaks lead to vinyl chloride concentrations of several hundred ppm at the leak source decreasing to levels that are indistinguishable from the background of 15 to 35 ppm total hydrocarbon within the distance of a few feet. This type of leak appears almost numberless, existing at almost every valve, flange, pump seal, shaft seal, in fact almost every point where the metal surface is discontinuous.

Because of the very localized nature of this type leak and the fact that the leakage rate is pressure dependent, this exposure will seldom be identified when monitoring a moving person. A standard incorporating a ceiling limit will simply mean that the number of citations issued against a company are totally dependent on the perseverance, determination, time and effort expended by the inspecting officer.

III. ORIGIN OF WORK PRACTICE RULES AND REGULATIONS

The work practice regulations proposed for vinyl chloride appear to have been simply transposed from the carcinogen standards with the substitution of only a different regulated material. These work practice rules were tediously developed for the fourteen (14) carcinogens, all of which appear to be either solids or liquids. Certainly it is not reasonable to expect the same procedure and practices to apply in handling a gaseous material without extensive revision and alteration. A few examples might be cited.

A. PROTECTIVE CLOTHING (PP 16897 Section C, third paragraph)

Garments that are impervious to vinyl chloride gas (<u>or resistant to the passage of vinyl chloride vapor</u>) are also impervious to air, body moisture, resistant to heat passage, and would tend to be extremely abrasive to the skin. Employees required to wear this type clothing would be subjected to almost intolerable work conditions. Since a gas cannot be easily isolated in only one local area, requirements for garment protection would be almost universal. Also, a garment of this type would tend to guarantee long-term exposure to the gas once inside the garment instead of allowing normal ventilation to replace the contaminated gas with uncontaminated air.

B. RESPIRATORY PROTECTION

Respiratory protection when working with solids or liquids is reasonably straightforward. When dealing with a colorless odorless gas, respiratory protection is either always necessary or never necessary. Implementing any program between these two extremes would be quite haphazard.

C. REGULATED AREAS

Establishing a regulated area for a gas is quite difficult but possible. The clothing changes required each time one exits a regulated area would be a great burden on employees permanently assigned to these areas when they wish to eat, drink, smoke, take a break or leave for supplies, etc.

D. SHOWER REQUIREMENTS WHEN CONTACTING VINYL CHLORIDE

Shower requirements after contamination with a solid or liquid are quite logical and reasonable. The need to shower after being contacted by a highly volatile material that evaporates almost immediately into a gas when contading a warm (body) surface is not clear.

E. EMERGENCY SITUATIONS

The objectives of medical surveillance within twenty-four (24) hours after being accidently exposed to vinyl chloride gas are not clear. After an employee is removed from an area containing vinyl chloride gas, there are no medical symptoms to be checked. Indeed, there are no reasonable diagnostic techniques presently available to detect any possible liver dysfunction arising from possible vinyl chloride exposure in its early, potentially treatable stages.

F. CONTAINER REQUIREMENTS

Placing a material containing a highly volatile liquid or a gas into a closed container creates numerous safety hazards during subsequent disposal.

IV. EFFECT OF WORK PRACTICE RULES

The following comments concerning the effect of work practice regulations will refer to the proposed permanent standard of unmeasurable vinyl chloride levels. With minor changes, these comments would apply to almost any permanent exposure level including the present 50 ppm standard. Though Firestone is in compliance with the emergency standard, this compliance relates only to exposure level, since work practice regulations were not included in the emergency standard. It should become clearer in the following discussion that the proposed work practice rules are without doubt the most difficult portion of the standard to comply with. In numerous instances they will impose such burdensome restrictions and regulations upon our employees that I honestly question our ability to either keep our present workforce or to secure replacements.

A. REGULATED AREAS

Based on the proposed permanent standard, the entire Pottstown Chemical Plant complex would become a regulated area including the following employees:

1. All production and maintenance employees
2. All management and clerical personnel
3. All lab personnel
4. Truck drivers bringing raw material into the plant or taking finished product out of the plant
5. Railroad personnel
6. Anyone else having occasion to enter any area of the plant or work in the immediate vicinity of the plant (security force, outside contractors, auditors, various fire and insurance inspectors, vendors, etc.)

The roster requirements for all these people would become a tremendous burden.

B. IMPLEMENTATION OF ENGINEERING CONTROLS AND WORK PRACTICE METHODS

Since the entire plant complex is periodically or continually exposed to levels above the detectable limit, the standard provides that immediate respiratory protection must be provided for and used by every employee in the complex. Because of the magnitude of exposure reduction necessary to bring a significant portion of the plant into compliance, use of respirators would be necessary for many years. Since there would be no unregulated areas in the plant, employees would become virtually immobile. Each time any employee found it necessary to move more than fifty (50) feet from his work station he would be required to switch to a portable back pack unit. Under these restrictions personal hygiene requirements become almost impossible.

In the course of performing the requirements of various plant jobs it is necessary for our employees to move about rather extensively around equipment, between floors of the three story poly buildings, up and down stairs, and distances of 30 to 50 feet from a central station. These requirements for mobility make permanent air stations and hoses totally impractical. A possible alternative is to supply affected employees with portable back pack air supply units (SCBA). A typical unit would be the MSA Model 401 portable breathing apparatus. This unit weighs twenty-eight (28) pounds and contains an air supply lasting only thirty minutes. Assuming an adequate safety factor of ten minutes, one would have to change tanks three times per hour, or perhaps purchase units with larger air supplies weighing fifty (50) to sixty (60) pounds. Changing of tanks would create great problems, since there are no plant areas containing undetectable vinyl chloride levels.

B. IMPLEMENTATION OF ENGINEERING CONTROLS AND WORK PRACTICE METHODS (Continued)

In addition, wearing a thirty (30) to sixty (60) pound back pack unit and a full face respirator on a hot summer day while trying to perform job duties with perspiration running in one's eyes and support straps rubbing the skin raw creates a work environment that no employee would subject himself to. If workers were to accept these conditions, their work output would decrease by 50 to 75%.

C. PROTECTIVE CLOTHING

Several comments concerning the use of protective clothing have been made in Section III. The combined requirements of respiratory protection and protective clothing during warm weather would make work conditions so oppressive that I cannot envision anyone continuing to work in the plant for more than a short time period. The requirement that all protective clothing be removed at each exit from a regulated area would, by itself, largely destroy worker output.

D. HYGIENE FACILITIES AND PRACTICES

The provision concerning consumption of food, beverages or smoking materials being restricted to nonregulated areas would also be impossible to implement until a larger portion of the plant could be brought into compliance with the proposed standard. All drinking fountains must be removed from the entire plant.

The proposed standard would make it necessary for us to construct new shower and lunchroom facilities in an area remote from the plant where no detectable vinyl chloride levels exist. Shower requirements after the last exit from a regulated area would necessitate an entirely new relief system with staggered work hours. This would eliminate any car pools that our employees have with Tire Plant people.

Another possibility would be to provide adequate facilities for the entire shift to shower simultaneously, at least one hundred (100) shower stalls. Each employee would then receive perhaps one-half hour overtime to shower but this would still destroy all car pools.

E. EMERGENCY SITUATIONS

The questionable value of special medical surveillance after emergency situations has already been discussed in Section III. If this requirement is implemented, along with an undetectable exposure level, the frequency of "emergency situations" will be so great that employees will remain under constant medical surveillance.

F. MAINTENANCE AND DECONTAMINATION

1. Placement of all waste materials, scrap, and process spills into closed containers which will prevent the release of vinyl chloride to the environment is technically possible but extremely problematical. In order to be reasonably safe, these containers must be capable of withstanding a pressure of approximately 100 PSIG. In addition, containers would have to be equipped with a relief mechanism in the event they are accidentally exposed to higher temperatures. This would make waste containers so heavy as to be practically immobile.

2. Based on the definition of contaminated systems in Section B, maintenance personnel would be required to wear and use whole-body air-supplied suits impervious to vinyl chloride and respirators for virtually every job in the plant. This would include all maintenance work on drying and finished product storage systems since present technology is not adequate to guarantee production of a resin that is totally free of residual vinyl chloride. Because of the extreme volatility of residual vinyl chloride, fairly rapid contamination of the enclosed air space above stored masses of resin is possible. The requirement for showering after removing protective equipment will again largely destroy maintenance output.

3. If protective clothing and equipment must be cleaned and dried after each use and also must be removed upon each exit from a regulated area, it is quite possible that as many as four (4) full suits of protective equipment must be supplied for each man.

G. TRANSPORTATION LOADING AND UNLOADING.

Paragraph 3 of Section m specifies that "employees engaged in transfer operations shall be provided with and required to wear respirators". Since monomer transfer operations are underway almost continuously in a poly building containing forty-two (42) reactors, every reactor operator must wear a respirator continuously regardless of the engineering controls, work practice methods, and exposure levels present in the reactor room. If one complies with the intent of this paragraph, it will also be necessary for all employees involved in the transfer of unstripped finished batches to wear respirators continuously, since this material contains approximately 10% residual monomer.

H. POLYMER HANDLING OPERATIONS

Item 1 in this section affects the entire trucking and rail industry whenever it is involved in transporting either bulk or bagged quantities of resin. For the reasons mentioned previously, it is quite likely that

levels of several hundred ppm residual monomers can be encountered in the enclosed air space above these large masses of resin.

This would also prohibit by implication shrouding resin pallets with plastic film, cardboard, etc. and containerized shipments since each of these methods of protecting resin during shipment causes residual monomer to concentrate above detectable levels in an enclosed unventilated area. People handling this material during shipment would be required to wear respirators since any accidental damage to the packaging or container would release detectable levels of vinyl chloride.

I. REPORTS

The incident reports required in Section Q of the standard will impose a truly staggering burden on industry if the specified exposure level remains at 0.

The requirement specifying individual written notification after exposure to detectable levels of vinyl chloride would rapidly bury employer and employees in paper.

V. CONCLUSION

Based on the foregoing comments, Firestone would have no alternative but to cease operations when the proposed standard becomes law. An intensive engineering study would be necessary to determine whether a significant portion of the plant could ever be brought into compliance based on the engineering controls and technology that presently exist. Certainly one must question whether investment of additional new capital greater than the total fixed asset value of a twenty-seven year old facility is economically prudent.

Perhaps the best that could be expected is that a portion of the plant would be reactivated after extensive changes and alterations. Even this course of action must be questioned since our total present manpower compliment would be necessary to achieve a production level no higher than fifty percent (50%) of current output. Considering the delivery times for equipment today, there is little hope that operations could be resumed before mid 1977.

Plants that have been constructed over the last ten years will find compliance with any standard exposure level an easier task for the following reasons:

1. Few if any new plants contain such a large number of reactors in two fully enclosed buildings. The large number of reactors in very close proximity along with the tremendous quantity of associated piping, valves, pumps, and seals make minor leakage conditions impossible to prevent.

2. The Pottstown plant contains three levels with a vertical process flow. This requires frequent travel between floors for certain operators in performing their job. Providing respiratory protection under these circumstances is exceptionally difficult.

   Most newer plants contain only two levels with polymerization and stripping being carried out on the same floor. This reduces dramatically the amount of travel that is necessary between floors.

3. Vessel size in newer plants is typically 2 to 14 times larger than our reactors (up to 50,000 gallons). Since potential leak locations are directly proportional to the number of reactors, their problems can be considered as being from 7% to 50% as great as those present in Pottstown.

4. Newer plants usually operate with a minimal product line at high throughput volumes as opposed to the Pottstown plant which operates with a complex, low volume, specialty product line.

5. The specialty type, lower volume, PVC resins are often much more difficult to manufacture with low residual monomer levels (< 100 ppm).

6. A large percentage of Pottstown's production is plastisol (dispersion resin). Since product quality considerations and drying techniques make it necessary to perform extensive screening operations on the latex, exposure problems are many times more severe than those encountered in suspension resin production.

7. Because of insurance and safety considerations, most new plants have separated polymerization, maintenance, laboratory, office, drying, and warehousing facilities. The entire Pottstown Chemical Plant is housed under a single discontinuous roof system, with hazardous areas separated only by fire walls.

8. During unexpected leaks (line failure, pump seal failure, operator errors, etc.) the "Emergency Ventilation" system is activated when the "Gas Alarm" is turned in. Under these emergency conditions, polymerization building air changes increase to 20 air changes per hour (approximately 160,000 CFM). This air is exhausted from the sides of the poly buildings and, under adverse atmospheric conditions, a high probability exists that it will be reintroduced into another area of the plant in

somewhat diluted form but containing discrete levels of vinyl chloride monomer.

It is technically possible to capture all this exhaust air in ductwork and convey it to a location remote from the plant, but the cost would be astronomical. A system of this type would require about 300 feet of 6 foot diameter, gas tight insulated ductwork along with a large fan discharging into some form of stack for each poly building.

R. W. Arnold

R. W. ARNOLD
FACTORY MANAGER
CHEMICAL PLANT

RWA:bjs
May 24, 1974

EFFECTS OF OSHA STANDARDS ON PLANT ECONOMICS

In the enclosed attachments the effects of OSHA standards on the capital cost, output, and personnel requirements at four different exposure levels are detailed. The four levels are as follows:

A. CASE I

Compliance to the current proposed standard of undetectable vinyl chloride levels.

B. CASE II

Exposure levels of 10 ppm TWA and 15 ppm ceiling.

C. CASE III

Exposure levels of 25 ppm TWA and 40 ppm ceiling.

D. CASE IV

50 ppm ceiling limit.

For each of these cases we have assumed that absolute compliance with the work practice rules as detailed in the proposed standard will be necessary. Capital cost estimates are primarily a function of the exposure levels that must be complied with. Productivity and labor requirements will be determined predominately by the work practice regulations.

In addition to the effects on capital cost, production level, and labor requirements that will result from the adoption of a new vinyl chloride standard, there will be phenominal increases in operating costs (overhead). Many of these increased operating expenses cannot be accurately determined without an intensive engineering study of the plant changes that will be necessary. To indicate the magnitude of these expenses, we can consider the incineration requirements that are necessary to comply to the proposed standard (CASE I).

On August 31, 1973, Catalytic Construction Company completed an engineering report for an incineration system to handle the hydrocarbon discharges from one of our existing spray dryers. Using this report as a basis, annual plant operating requirements for incineration are estimated as follows:

1. Annual Operating Cost

1.5 to 2 Million Dollars/Year

2. Fuel Oil Requirements

4 to 5 Million Gallons/Year

3. Electricity Requirements

Approximately 5 Million Kilowatt Hours/Year

This system does not include equipment to remove sulphur oxides from the discharge stream; therefore, pollution levels would be increased or capital cost requirements would increase to cover the additional scrubber installation.

The increased ventilation requirements for most plant areas will also greatly increase steam consumption for heating purposes. A rough estimate would be that steam usage for heating will double, requiring an additional 0.5 to 1.0 million gallons of oil each year. In order to supply these increased steam requirements, it would probably be necessary for common services to install an additional steam boiler, an expense that has not been included in our capital estimates (since steam is a purchased utility). It is estimated that the additional ventilation equipment, process equipment, air supply equipment, etc., will consume electrical power in the range of 15 to 20 million kilowatt hours per year (not including the requirements for incineration). With the universal energy shortage existing today, one must logically question whether these increased energy requirements could be satisfied.

All of these changes are predicted on the assumption that the EPA will approve them. Certainly EPA concern over the levels of vinyl chloride discharged to the atmosphere will increase and it is quite likely that several of the contemplated changes could not be implemented without additional capital expenditures to satisfy EPA requirements.

The projections also assume that we will be able to obtain the necessary additional people to continue plant operation. For years, we have had difficulty in hiring adequate numbers of craftsmen (mechanics, pipefitters, etc.) to meet our past needs. With the currently required medical testing, and the exceedingly difficult work conditions, obtaining the number of people necessary for a 400% increase in maintenance staff seems hardly possible. An essentially similar situation will exist in all other plant areas. A possible solution to this dilemma would be to substantially increase wages, making an unpleasant job at least more rewarding, if not more attractive. The work practices will also lead to a large increase in employee turnover.

With the vastly increased maintenance level necessary to meet the lower exposure levels, maintenance spare parts inventory could easily triple. The stringent work practice regulations will dictate that entire systems be removed to be repaired in a remote location rather than being repaired in place. This includes items such as pumps, valves, piping, and virtually all equipment that would be classified as "contaminated".

The vast amount of data concerning entry into regulated areas, medical records, monitoring results, emergency situations, and accidental exposures to vinyl chloride will require a totally new system of data storage and retrieval. Certainly these quantities of data could not be stored as paper summaries in file cabinets. The Chemical Plant would eventually require a separate Data Processing Department.

Other areas of potential capital or operating expense are:

1. Continuing expense for protective clothing replacement.

2. Medical testing programs.

3. Increased insurance rates.

4. Increased workman's compensation claims.

5. Probable need for new fire protection system. With the additional equipment and buildings and forced ventilation in our warehouse, demand on our existing fire protection system would most likely exceed design. This would mean installation of new fire lines and probably a new fire water reservoir.

6. Increased electrical requirements may make it necessary to supply additional electric lines into the plant (along with switch gear and sub stations).

7. Continuing expenses for renewal and replacement of respiratory equipment.

8. Purchase of railroad equipment to move cars around plant property. It is unlikely that railroad personnel will agree to come on plant property under Case I.

9. Leasing of equipment and drivers to bring all truck trailers onto plant property for either delivery or loading under Case I.

10. Charges by outside contractors would increase drastically. (Roof repair, shutdown requirements, equipment servicing, etc.)

Please note a factor of 33% was used for Contingencies and Escalation in Case I, Case II and Case III, while 25% was used in Case IV. Field information indicates that Engineering Companies are using project cost escalation factors of 33 to 37% for projects to be completed in the next two years. Since a major portion of the capital expenditure consists of projects with completion targets 2½ to 4 years AFTER PROJECT APPROVAL, the escalation allowance may be conservative.

RWA/bjs

5/30/74

CASE 1 - CURRENT PROPOSED STANDARD - NO DETECTABLE LEVEL

1797

CAPITAL REQUIREMENTS

1. TANK FARM - REGULATED AREA

	CAPITAL COST (IN THOUSANDS)	TIME TO INSTALL *
A. CHANGES IN WORK PRACTICE		
1. Back pack unit and protective clothing for pipefitters and hooking up vinyl cars for unloading (3)	2.2	10 Wks.
2. Full face mask, demand regulator, hose and back pack for tank farm operator, tank farm relief man and centrifuge man at waste treatment. Protective clothing for these men (7)	5.6	10 Wks.
3. Back pack unit and protective clothing for rubber lab sample man (3)	2.1	10 Wks.
4. Back pack units for bulk delivery drivers, dumpster operators and railroad personnel (8)	6.4	10 Wks.
	$ 16.3	
B. ENGINEERING CONTROLS		
1. Two canned vinyl chloride unloading pumps to eliminate seal leaks	$ 10.0	30 Wks.
2. Canned sphere transfer pump	9.0	30 Wks.
3. Three canned transfer pumps - sphere to refrigerated storage	19.0	30 Wks.
4. Four canned transfer pumps from refrigerated storage to reactor rooms and Pilot Plant	25.0	30 Wks.
5. Three centrifugal compressors for unloading vinyl chloride tank cars	90.0	52 Wks.
6. One centrifugal compressor for oil column	45.0	52 Wks.
7. Additional piping and valves for revised pump arrangement	20.0	
8. Fume incinerator for oil column vent	20.0	See Item 4.B.1
9. Purge system for vinyl unloading lines to incinerator	25.0	See Item 4.B.1
10. Portable unit for airing out storage vessels for cleaning	25.0	
	$ 288.0	
TANK FARM TOTAL	$ 304.3	

*Time from Project Approval to installation.

2. POLYMERIZATION BUILDINGS - REGULATED AREA

	CAPITAL COST (IN THOUSANDS)	TIME TO INSTALL
A. CHANGES IN WORK PRACTICE		
1. Full face mask demand regulator, hose, back pack and protective clothing for reactor operators, stripper operators, relief operators, area fitters, utility & service, lab sample men and foremen (67)	$ 53.0	10 Wks.
2. Air tight containers for removing scrap from buildings	15.0	24 Wks.
	$ 68.0	
B. ENGINEERING CONTROLS		
1. Double stripping capacity	$2,000.0	2½ Years
2. Permanent air system for plant (breathing air)	300.0	52 Wks.
3. Five canned vinyl charge pumps	30.0	30 Wks.
4. Three canned charge pumps	19.0	30 Wks.
5. Two canned special pumps	11.0	30 Wks.
6. Replace all gate valves with ball valves - 2"	28.5	
3"	26.0	52 Wks.
4"	30.0	
6"	41.4	
7. (24) stripper seal pumps	24.0	42 Wks.
8. (24) sealless transfer pumps - strippers to blend tanks	96.0	52 Wks.
9. Two stripper steam purge systems for cleaning	40.0	See 2.B.
10. Seal off all pot strainers, screens and other process areas and ventilate	300.0	48 Wks.
11. Totally enclosed floc removal system	180.0	18 Mo.
12. Replace existing compressors with Nash rotary compressors (8)	400.0	18 Mo.
13. Replace all existing blend tanks with pressure rated vessels--full vacuum to 100 PSIG, with controls	4,200.0	3-4 Year
14. Replace existing jets with Nash Hytor pumps (7)	140.0	42 Wks.

B. ENGINEERING CONTROLS (Continued)	CAPITAL COST (IN THOUSANDS)	TIME TO IMPLEMENT
15. Incinerate all emissions from both buildings (Nash, drop line ventilation, purge, etc.)	150.0	See Item 4.B.1
16. Ductwork on stripper level (both buildings) to keep reactors under negative pressure while cleaning	100.0	36 Wks.
17. Replace all reactor drawbars with a new design	130.0	52 Wks.
18. Duct all building ventilation air to a point remote from plant complex (building ventilation exhaust fans)	600.0	52 Wks.
	$8,845.9	
POLYMERIZATION BUILDINGS TOTAL	$8,913.9	

3. BULK AREA - REGULATED AREA

A. CHANGES IN WORK PRACTICE		
1. Full face mask, demand regulator, hose, back pack unit, protective clothing for centrifuge men, baggers, utility & service and foremen (21)	$ 16.8	10 Wks.
2. Three portable air systems for truckers	4.5	10 Wks.
3. Back pack unit for outside truckers (3)	1.3	10 Wks.
4. Air tight containers for overflow to replace tote bins and drums	100.0	48 Wks.
	$ 122.6	

B. ENGINEERING CONTROLS		
1. Four sealless slurry feed pumps	$ 30.0	30 Wks.
2. Seal off centrifuge mezzanine and ventilate	30.0	24 Wks.
3. Incinerate dryer exhausts	900.0	2-3 Years
4. Vent system for silos, trucks, cars and tote bins; incinerate all vapors	250.0	See Item 3.B.3
5. Exhaust hoods for baggers and saddlebagger	60.0	36 Wks.
6. Label making machine	10.0	16 Wks.
7. Close Bird effluent system--exhaust and incinerate	50.0	See Item 3.B.3
8. Additional makeup ventilation air and exhaust system for ventilation air	75.0	36 Wks.
	$1,405.0	
TOTAL BULK AREA	$1,527.6	

	CAPITAL COST (IN THOUSANDS)	TIME TO INSTALL
4. SPRAY DRYERS - REGULATED AREA		
A. CHANGES IN WORK PRACTICE		
1. Full face mask, demand regulator, hose, back pack and protective clothing for centrifuge men, baggers, paste man, Line 5 baggers and foremen (39)	$ 31.2	10 Wks.
2. Portable air system for truckers	4.5	10 Wks.
3. Air tight containers for screen overflow	30.0	48 Wks.
	$ 65.7	
B. ENGINEERING AND GENERAL PLANT		
1. Incinerate dryer stack gases & Poly Bldg.	$4,200.0	2-4 Year
2. Wall off Moynos and pot strainers, ventilate and incinerate	250.0	See Item 4.B.2
3. Automatic baggers and palletizer	500.0	2 Years
4. Labeling machine	10.0	16 Wks.
	$4,960.0	
TOTAL SPRAY DRYERS	$5,025.7	
5. WAREHOUSE AND GENERAL PLANT - REGULATED AREA		
A. CHANGES IN WORK PRACTICE		
1. Portable air system for truckers (6)	$ 9.0	10 Wks.
2. Full facemask, demand regulator, hose back pack and protective clothing for warehouse utility and foremen (9)	7.2	10 Wks.
3. Full face mask, demand regulator, hose, back pack and protective clothing for maintenance men (80)	40.0	10 Wks.
4. Full face mask, demand regulator, hose back pack, and protective clothing for office and lab personnel (100)	80.0	10 Wks.
	$ 136.2	

B. ENGINEERING CONTROLS	CAPITAL COST (IN THOUSANDS)	TIME TO INSTALL
1. New break area, lockerrooms, showers--men and women, clockcard and salaried	$ 500.0	20 Mo.
2. Move offices out of regulated area (plant management and support groups)	500.0	20 Mo.
3. Fixed VCM monitoring system	500.0	48 Wks.
4. Scrap incinerator	2,500.0	2-3 Years
5. Signs posting regulated areas	5.0	10 Wks.
6. Fresh air ventilation and exhaust system for warehouse	125.0	42 Wks.
7. Fresh air ventilation and exhaust system for labs	20.0	42 Wks.
8. Additional hoods for mills, sinks, sample storage area, paste makeup area, ovens, etc.	20.0	42 Wks.
	$4,170.0	
TOTAL WAREHOUSE AND GENERAL PLANT	$4,306.2	
GRAND TOTAL	$20,077.7	
INSTALLATION	Included Above	
ENGINEERING - 10%	$2,007.8	$22,085.5
CONTINGENCIES & ESCALATION - 33%	$7,288.2	$29,373.7
INSURANCE		
TAXES		

OTHER COMMENTS

1. A medical facility may be required to examine exposed employees.
2. Parking lot would have to be relocated or enclosed.
3. Extensive additional record keeping would be required to report incidents to OSHA.
4. Full air supplied impervious body suits would be required for maintenance or production personnel working on contaminated equipment. Cost estimate not known.
5. NOTE: We have little confidence that even these extensive changes will permit us to comply with the undetectable vinyl chloride level specified in the proposed standard. The extent of exposure reduction is difficult to predict, since the industry has no engineering expertise in high volume production of material carrying this type of hazard classification.

CWE/KHG/bjs
5/26/74

MANPOWER REQUIREMENTS - CASE I

1.	Production manpower	33% Increase
2.	Maintenance manpower (due to work practices and increased physical plant)	400% Increase
3.	Supervision	50% Increase
4.	Engineering and Technical	100% Increase
5.	Clerical and Secretarial	200% Increase
6.	Laboratory personnel	50% Increase
7.	Janitorial (24 hour basis)	200% Increase

Manpower estimates are on the low side since no provision has been made to man the additional equipment. This manning cannot be estimated until detailed engineering studies are completed. Also, no manpower increases in supporting departments are included (accounting, data processing, industrial relations, security force, ground crews, etc.)

PRODUCTION LEVEL - CASE I

Estimated Yearly Production 85 to 95 Million Pounds

Because of the exceptionally restrictive work practice rules, it is doubtful that production could ever be restored to present levels. The production manpower increase of 33% is for the purpose of instituting a relief system similar to that used in other industries where work conditions are oppresive. Further increases in production manpower would have little effect on output; people would just be in each others way.

Two possibilities for increasing production levels come to mind:

1. Revise support equipment upstream and downstream of the reactors.

   This would essentially create a greater number of process lines, each one serving fewer reactors. Installation of additional equipment of this nature in an old plant is not feasible because of space limitations.

2. Computerize polymerization and stripping operations.

   Computerization of these operations would permit us to approach current production levels with essentially no additional manpower above that detailed in the Manpower Requirements table.

CASE II - 10 PPM TWA AND 15 PPM CEILING

CAPITAL REQUIREMENTS

1. TANK FARM - REGULATED AREA	CAPITAL COST (IN THOUSANDS)	TIME TO INSTALL
A. CHANGES IN WORK PRACTICE		
1. Back pack unit and protective clothing for pipefitters and hooking up vinyl cars for unloading (3)	$ 2.2	10 Wks
2. Full face mask, demand regulator, hose and back pack for tank farm operator, tank farm relief man and centrifuge man at waste treatment. Protective clothing for these men (7)	5.6	10 Wks
3. Back pack unit and protective clothing for rubber lab sample man (3)	2.1	10 Wks
	$ 9.9	
B. ENGINEERING CONTROLS		
1. Two canned vinyl chloride unloading pumps to eliminate seal leaks	$ 10.0	30 Wks
2. Canned sphere transfer pump	9.0	30 Wks
3. Three canned transfer pumps - sphere to refrigerated storage	19.0	30 Wks
4. Four canned transfer pumps from refrigerated storage to reactor rooms and Pilot Plant	25.0	30 Wks
5. Three centrifugal compressors for unloading vinyl chloride tank cars	90.0	52 Wks
6. One centrifugal compressor for oil column	45.0	52 Wks
7. Additional piping and valves for revised pump arrangement	20.0	
8. Fume incinerator for oil column vent	20.0	See It 4.B.1
9. Purge system for vinyl unloading lines to incinerator	25.0	See It 4.B.1
10. Portable unit for airing out storage vessels for cleaning	25.0	30 Wks
	$ 288.0	
TANK FARM TOTAL	$ 297.9	

*Time from Project Approval to installation.

P. POLYMERIZATION BUILDING - REGULATED AREA

		CAPITAL COST (IN THOUSANDS)	TIME TO IMPLEMENT
A.	CHANGES IN WORK PRACTICE		
1.	Full face mask demand regulator, hose and protective clothing for reactor operators, stripper operators, relief operators, area fitters, utility & service, lab sample men and foremen (67)	$ 53.6	10 Wks.
2.	Air tight containers for removing scrap from buildings	15.0	24 Wks.
		$ 68.6	
B.	ENGINEERING CONTROLS		
1.	Double stripping capacity	$ 2,000.0	2-5 Yr.
2.	Permanent air system for plant excluding warehouse and offices (Breathable Air)	250.0	46-52 Wks
3.	Five canned vinyl charge pumps	30.0	30 Wks
4.	Three canned charge pumps	19.0	30 Wks
5.	Two canned special pumps	11.0	30 Wks
6.	Replace all gate valves with ball valves - 2"	28.5	
	3"	26.0	52 Wks
	4"	30.0	
	6"	41.4	
7.	(24) stripper seal pumps	24.0	42 Wks
8.	(24) sealless transfer pumps - strippers to blend tanks	96.0	52 Wks
9.	Two stripper steam purge systems for cleaning	40.0	See 2.B.12
10.	Seal off all pot strainers, screens and other process areas and ventilate	300.0	48 Wks
11.	Totally enclosed floc removal system	180.0	18 Mo.
12.	Replace existing compressors with Nash rotary compressors (8)	400.0	18 Mo.
13.	Replace all existing blend tanks with pressure rated vessels--full vacuum to 100 PSIG, with controls	4,200.0	3-4 Yr
14.	Replace existing jets with Nash Hytor pumps (7)	140.0	42 Wks

ONLY COPY AVAILABLE

1805

	CAPITAL COST (IN THOUSANDS)	TIME TO INSTALL
B. ENGINEERING CONTROLS (CONTINUED)		
15. Incinerate all emissions from both buildings (Wash, drop line ventilation, purge, etc.)	$ 150.0	See II 4.B.1
16. Ductwork on stripper level (both buildings) to keep reactors under negative pressure while cleaning	100.0	36 Wks
17. Replace all reactor drawbars with a new design	130.0	52 Wks
18. Duct all building ventilation air to a point remote from plant complex (building ventilation exhaust fans)	600.0	52 Wks
	$ 8,795.9	
POLYMERIZATION BUILDINGS TOTAL	$ 8,864.5	
3. BULK AREA - REGULATED AREA		
A. CHANGE IN WORK PRACTICE		
1. Full face mask, demand regulator, hose, protective clothing for centrifuge men, baggers, utility & service and foremen (21)	$ 10.0	10 Wks
2. Air tight containers for overflow to replace tote bins and drums	100.0	48 Wks
	$ 110.0	
B. ENGINEERING CONTROLS		
1. Four sealless slurry feed pumps	$ 30.0	30 Wks
2. Seal off centrifuge mezzanine and ventilate	30.0	24 Wks
3. Incinerate dryer exhausts	900.0	2-3 Yr
4. Vent system for silos, bulk trucks, bulk cars and tote bins	250.0	1-2 Yr
5. Exhaust hoods for baggers and saddle-bagger	60.0	36 Wks
6. Label making machine	10.0	16 Wks
7. Close Bird effluent system--exhaust and incinerate	50.0	
8. Additional makeup ventilation air and exhaust system for ventilation air	75.0	36 Wks
	$ 1,405.0	
TOTAL BULK AREA	$ 1,515.0	

	CAPITAL COST (IN THOUSANDS)	TIME TO IMPLEMENT
4. SPRAY DRYERS - REGULATED AREA		
A. CHANGES IN WORK PRACTICE		
1. Full face mask, demand regulator, hose and protective clothing for centrifuge men, baggers, paste man, Line 5 baggers and foremen (36)	$ 20.0	10 Wks
2. Air tight containers for screen overflow	30.0	48 Wks
	$ 50.0	
B. ENGINEERING AND GENERAL PLANT		
1. Incinerate dryer stack gases	$ 4,200.0	2-4 Yrs
2. Wall off Moynos and pot strainers, ventilate and incinerate	250.0	
3. Automatic baggers and palletizer	500.0	2 Yrs.
4. Labeling machine	10.0	16 Wks
	$ 4,960.0	
TOTAL SPRAY DRYERS	$ 5,010.0	
5. WAREHOUSE AND GENERAL PLANT - PARTIALLY REGULATED AREA		
A. CHANGES IN WORK PRACTICE		
1. Protective clothing for warehouse utility and foremen (9)	$ 1.0	10 Wks
2. Full face mask, demand regulator, hose back pack and protective clothing for maintenance men (50)	40.0	10 Wks
3. Protective clothing for lab personnel (25)	2.5	10 Wks
	$ 43.5	
B. ENGINEERING CONTROLS		
1. Increase size of and air condition (enclose) break area, lockerrooms, showers--men and women, clockcard and salaried	$ 100.0	52 Wks
2. Fixed VCM monitoring system, less extensive than Case I (approx. 3/5)	300.0	48 Wks

B. ENGINEERING CONTROLS (CONTINUED)	CAPITAL COST (IN THOUSANDS)	TIME TO INSTALL
3. Scrap incinerator	$ 2,500.0	2-3 Yrs
4. Signs posting regulated areas	5.0	10 Wks.
5. Fresh air ventilation and exhaust system for warehouse	125.0	42 Wks.
6. Fresh air ventilation and exhaust system for labs	20.0	42 Wks.
7. Additional hoods for mills, sinks, sample storage area, paste makeup area, ovens, etc.	20.0	42 Wks.
	$ 3,070.0	
TOTAL WAREHOUSE AND GENERAL PLANT	$ 3,113.5	
GRAND TOTAL	$18,800.9	
INSTALLATION	Included Above	
ENGINEERING - 10%	$ 1,880.0	$20,680.
CONTINGENCIES & ESCALATION 33%	$ 6,824.7	$27,505.
INSURANCE		
TAXES		

OTHER COMMENTS

1. A medical facility may be required to examine exposed employees.

2. Extensive additional record keeping would be required to report incidents to OSHA.

3. Full air supplied impervious body suits would be required for maintenance or production personnel working on contaminated equipment. Cost estimate not known.

4. Capital requirements for Case II are not appreciably different from Case I, but we believe these levels could be complied with based on present engineering expertise and current technology. There would be certain areas within the plant where masks are never necessary, but most would still fall into a "Regulated Area" classification based on the definition given in the standard. Perhaps the only two non-regulated areas would be the general offices and the lunch area - locker room complex. It would be

OTHER COMMENTS (CONTINUED)

almost impossible to enforce the clothing changes provisions of the standard for people traveling into and out of the two non-regulated areas.

MANPOWER REQUIREMENTS - CASE II

Manpower requirements will be little different than Case I, primarily because of the overly demanding work practice regulations and the vastly similar capital requirements program.

1.	Production manpower	33% Increase
2.	Maintenance manpower	400% Increase
3.	Supervision	50% Increase
4.	Engineering and Technical	100% Increase
5.	Clerical and Secretarial	150% Increase
6.	Laboratory personnel	50% Increase
7.	Janitorial (24 hour basis)	200% Increase

No provision has been made in Manpower Table for manning of additional installations. Maintenance manpower has been adjusted for the increased physical plant.

PRODUCTION LEVEL - CASE II

Estimated Yearly Production 120 to 130 Million Pounds

Because there will be several plant areas where masks will not be necessary except during emergency (warehouse, bulk drying area, spray dryer operation, offices, labs, maintenance shop) and because the lunch area and locker room facilities can remain on site, productivity should increase to approximately 70% of present levels. There will still be extensive holdups in the tank farm and polymerization building areas.

RWA:vjm
5/28/74

CASE III - 25 ppm TWA AND 40 ppm CEILING

CAPITAL REQUIREMENTS

1. TANK FARM - REGULATED AREA

		CAPITAL COST (IN THOUSANDS)	TIME TO INSTALL*
A.	CHANGES IN WORK PRACTICE		
1.	Back pack unit and protective clothing for pipefitters hooking up vinyl cars for unloading (3)	$ 2.2	10 Wks.
2.	Full face mask, demand regulator, hose and back pack for tank farm operator, tank farm relief man and centrifuge man at waste treatment. Protective clothing for these men (7)	5.6	10 Wks.
3.	Back pack unit and protective clothing for rubber lab sample man (3)	2.1	10 Wks.
		$ 9.9	
B.	ENGINEERING CONTROLS		
1.	Three canned transfer pumps - sphere to refrigerated storage	$ 19.0	30 Wks.
2.	Four canned transfer pumps from refrigerated storage to reactor rooms and Pilot Plant	25.0	30 Wks.
3.	Three centrifugal compressors for unloading vinyl chloride tank cars	90.0	52 Wks.
4.	Additional piping and valves for revised pump arrangement	16.0	
5.	Extend stack for oil column vent	5.0	10 Wks.
6.	Purge system for vinyl unloading lines to stack	25.0	30 Wks.
7.	Portable unit for airing out storage vessels for cleaning	15.0	30 Wks.
		$ 195.0	
	TANK FARM TOTAL	$ 204.9	

*Time from Project Approval to installation.

2. POLYMERIZATION BUILDINGS - REGULATED AREA

	CAPITAL COST (IN THOUSANDS)	TIME TO INSTALL
A. CHANGES IN WORK PRACTICE		
1. Full face mask, demand regulator, hose, protective clothing for reactor operators, stripper operators, relief operators, area fitters, utility & service and foremen (60)	$ 48.0	10 Wks.
2. Air tight containers for removing scrap from buildings	15.0	24 Wks.
	$ 63.0	
B. ENGINEERING CONTROLS		
1. Increase stripping capacity	$1,500.0	2½ Yrs.
2. Permanent air system for poly buildings and tank farm	150.0	52 Wks.
3. Five canned vinyl charge pumps	30.0	30 Wks.
4. Three canned charge pumps	19.0	30 Wks.
5. Two canned special pumps	11.0	30 Wks.
6. Replace frequently used gate valves with ball valves - 2"	14.8	48 Wks.
3"	18.0	
4"	24.0	
6"	35.0	
7. Seal off all pot strainers, screens and other process areas and ventilate	300.0	48 Wks.
8. Totally enclosed floc removal system	140.0	18 Mo.
9. Replace existing compressors with Nash rotary compressors (8)	400.0	18 Mo.
10. Install ventilation system to all blend tanks (incinerate)	200.0	See Item 4.B.1
11. Replace existing jets with Nash Hytor pumps (7)	140.0	42 Wks.
12. Incinerate all emissions from both buildings (Nash, drop line ventilation, purge, etc.)	150.0	See Item 4.B.1
13. Ductwork on stripper level (both buildings) to keep reactors and strippers under negative pressure while cleaning	100.0	36 Wks.
14. Duct all building ventilation air to a point remote from plant complex (building ventilation exhaust fans)	600.0	52 Wks.
	$3,831.8	
POLYMERIZATION BUILDINGS TOTAL	$3,894.8	

		CAPITAL COST (IN THOUSANDS)	TIME TO INSTALL
3.	BULK AREA - REGULATED AREA		
A.	CHANGES IN WORK PRACTICE		
1.	Protective clothing for centrifuge men, baggers, utility & service and foremen (21)	$ 2.1	10 Wks.
B.	ENGINEERING CONTROLS		
1.	Extend dryer exhausts approximately 60 feet	$ 20.0	24 Wks.
2.	Ventilation system for silos, bulk trucks, bulk cars and tote bins	75.0	44 Wks.
3.	Ducting baggers and saddlebagger to reduce dusting only	40.0	24 Wks.
4.	Label making machine	10.0	16 Wks.
		$ 145.0	
	TOTAL BULK AREA	$ 147.1	
4.	SPRAY DRYERS - REGULATED AREA		
A.	CHANGES IN WORK PRACTICE		
1.	Protective clothing for centrifuge men, baggers, paste man, Line 5 baggers and foremen (39)	$ 3.9	10 Wks.
B.	ENGINEERING AND GENERAL PLANT		
1.	Incinerate dryer stack gases (three dryers, 200,000 cfm)	$2,700.0	2-3 Yrs.
2.	Increased ventilation at Moynos and pot strainers	100.0	48 Wks.
		$2,800.0	
	TOTAL SPRAY DRYERS	$2,803.9	
5.	WAREHOUSE AND GENERAL PLANT - NON-REGULATED AREA		
A.	CHANGES IN WORK PRACTICE		
1.	Full face mask, demand regulator, hose, back pack and protective clothing for maintenance men (50)	$ 40.0	10 Wks.

B. ENGINEERING CONTROLS	CAPITAL COST (IN THOUSANDS)	TIME TO INSTALL
1. Increase size of and air condition break area, lockerrooms, showers--men and women, clockcard and salaried	$ 100.0	52 Wks.
2. Fixed VCM monitoring system for poly buildings and tank farm	250.0	48 Wks.
3. Signs posting regulated areas	5.0	10 Wks.
	$ 355.0	
TOTAL WAREHOUSE & GENERAL PLANT	$ 395.0	
GRAND TOTAL	$7,445.7	
INSTALLATION	Included Above	
ENGINEERING - 10%	$ 744.6	$ 8,190.3
CONTINGENCIES & ESCALATION - 33%	$2,702.8	$10,893.1
INSURANCE		
TAXES		

OTHER COMMENTS

1. Increased medical facilities will be required to examine exposed employees.

2. Extensive additional record keeping would be required to report incidents to OSHA.

3. Full air supplied impervious body suits would be required for maintenance or production personnel working on contaminated equipment. COST ESTIMATE NOT KNOWN.

MANPOWER REQUIREMENTS - CASE III

1.	Production Manpower	20% Increase
2.	Maintenance Manpower	200% Increase
3.	Supervision	25% Increase
4.	Engineering and Technical	50% Increase
5.	Clerical and Secretarial	100% Increase
6.	Laboratory Personnel	30% Increase
7.	Janitorial (24 hour basis)	200% Increase

Manpower increases should be fairly accurate. Maintenance, clerical and janitorial manpower remains high because of work practices, record keeping, and housekeeping requirements respectively.

PRODUCTION LEVEL - CASE III

Estimated Yearly Production 140 to 150 Million Pounds

We would hope to achieve the higher side of this estimate after about a year of refinements. Mask requirements while transfering vinyl chloride will be a major production holdup. Except for these areas (monomer transfer operations), mask use would be necessary only during emergencies. (leaks)

RWA/bjs

5/26/74

CASE IV - 50 ppm CEILING LIMIT

CAPITAL REQUIREMENTS

	CAPITAL COST (IN THOUSANDS)	TIME TO INSTALL *
1. TANK FARM - REGULATED AREA		
A. CHANGES IN WORK PRACTICE		
1. Back pack unit and protective clothing for pipefitters hooking up vinyl cars for unloading (3)	$ 2.2	10 Wks.
2. Full face mask, demand regulator, hose and back pack for tank farm operator, tank farm relief man and centrifuge man at waste treatment. Protective clothing for these men (7)	5.6	10 Wks.
3. Back pack unit and protective clothing for rubber lab sample man (3)	2.1	10 Wks.
	$ 9.9	
B. ENGINEERING CONTROLS		
1. Three centrifugal compressors for unloading vinyl chloride tank cars	$ 90.0	52 Wks.
2. Purge system for vinyl unloading lines to stack	25.0	30 Wks.
3. Portable unit for airing out storage vessels for cleaning	25.0	30 Wks.
4. Miscellaneous ventilation changes	50.0	48 Wks.
	$ 190.0	
TANK FARM TOTAL	$ 199.9	
2. POLYMERIZATION BUILDINGS - REGULATED AREA		
A. CHANGES IN WORK PRACTICE		
1. Full face mask, demand regulator, hose and protective clothing for reactor operators, stripper operators, relief operators, area fitters, utility & service, lab sample men and foremen (60)	$ 48.0	10 Wks.
2. Air tight containers for removing scrap from buildings	15.0	24 Wks.
	$ 63.0	

*Time from Project Approval to installation.

	CAPITAL COST (IN THOUSANDS)	COST TO INSTALL
B. ENGINEERING CONTROLS		
1. Improved plastisol stripping process	$ 250.0	14 Mo.
2. Permanent air system for poly buildings and tank farm (Breathable Air)	150.0	
3. Replace leaking gate valves with ball valves - 2"	5.0	
3"	9.0	
4"	12.0	38 Wks.
6"	17.5	
4. Seal off all pot strainers, screens and other process areas and ventilate	300.0	48 Wks.
5. Ventilate all existing blend tanks	200.0	See Item 4.B.1
6. Ductwork on stripper level (both buildings) to keep reactors and strippers under negative pressure while cleaning	100.0	36 Wks.
	$1,043.5	
POLYMERIZATION BUILDINGS TOTAL	$1,106.5	
3. BULK AREA - REGULATED AREA		
A. CHANGES IN WORK PRACTICE		
1. Protective clothing for centrifuge men, baggers, utility & service and foremen (21)	$ 2.1	10 Wks.
B. ENGINEERING CONTROLS		
1. Ventilation system for loading bulk trucks and cars	$ 75.0	44 Wks.
2. Ducting for baggers and saddlebagger to reduce dusting	40.0	24 Wks.
3. Label making machine	10.0	16 Wks.
	$ 125.0	
TOTAL BULK AREA	$ 127.1	

	CAPITAL COST (IN THOUSANDS)	TIME TO INSTALL
4. SPRAY DRYERS - REGULATED AREA		
A. CHANGES IN WORK PRACTICE		
1. Protective clothing for centrifuge men, baggers, paste man, Line 5 baggers and foremen (39)	$ 3.9	10 Wks.
B. ENGINEERING AND GENERAL PLANT		
1. Incinerate dryer stack gases (1 dryer, 70,000 cfm)	$1,800.0	2 Years
2. Increased ventilation at Moynos and pot strainers	100.0	48 Wks.
	$1,900.0	
TOTAL SPRAY DRYERS	$1,903.9	
5. WAREHOUSE AND GENERAL PLANT - REGULATED AREA		
A. CHANGES IN WORK PRACTICE		
1. Full face mask, demand regulator, hose, back pack, and protective clothing for maintenance men (50)	$ 40.0	10 Wks.
B. ENGINEERING CONTROLS		
1. Enclose break area, expand lockerrooms, showers--men and women, clockcard and salaried	$ 100.0	52 Wks.
2. Pipe all equipment and floor drain lines outside buildings	20.0	24 Wks.
3. Fixed VCM monitoring system for poly buildings and tank farm	250.0	48 Wks.
4. Signs posting regulated areas	5.0	10 Wks.
	$ 375.0	
TOTAL WAREHOUSE AND GENERAL PLANT	$ 415.0	
GRAND TOTAL	$3,752.4	
INSTALLATION	Included Above	
ENGINEERING - 10%	375.2	$4,127.6
CONTINGENCIES & ESCALATION - 25%	$1,031.9	$5,159.5
INSURANCE		
TAXES		

OTHER COMMENTS

1. Increased medical facilities will be required to examine exposed employees.

2. Extensive additional record keeping would be required to report incidents to OSHA.

3. Full air supplied impervious body suits would be required for maintenance or production personnel working on contaminated equipment. COST ESTIMATE NOT KNOWN.

4. NOTE: The large increase in capital cost requirements above previous estimates is due to implementation of the work practice rules and because respiratory protection can be used as only an interim measure while engineering controls are being developed.

MANPOWER REQUIREMENTS - CASE IV

1.	Production Manpower	20% Increase
2.	Maintenance Manpower	150% Increase
3.	Supervision	25% Increase
4.	Engineering and Technical	50% Increase
5.	Clerical and Secretarial	100% Increase
6.	Laboratory Personnel	30% Increase
7.	Janitorial (24 hour basis)	200% Increase

Again, work practice regulations will substantially increase manpower.

PRODUCTION LEVEL - CASE IV

Estimated Yearly Production 150 to 160 Million Pounds

RWA/bjs

5/26/74

SOURCES OF VINYL CHLORIDE TO AMBIENT AIR IN PLANT

Please refer to Flow Diagrams. Items marked with * are areas of actual or potential exposure to 50 ppm vinyl chloride or higher that pose problems because of exposure frequency or high exposure level.

I. TANK FARM

A. Rail Car unloading

1. Gasketing at hose connections
* 2. Pump seals
* 3. Compressors
4. Flanges at pipe joints
* 5. Valves leaking
6. Venting pressure off hoses before disconnecting
* 7. Lab sampling of vinyl chloride cars

B. Transfer Operations (From 25,000 gallon storage tanks, to sphere, to refrigerated storage tanks, to weigh tanks)

1. Pipe flanges
* 2. Pump seals
* 3. Valves leaking
* 4. Compressors
* 5. Lab sampling of stored vinyl chloride
6. Airing out tanks for pressure inspection or cleaning

II. POLYMERIZATION BUILDING - REACTOR ROOM

* A. Pump seals
B. Flanged pipe joints or vessel connections
* C. Reactor heads
D. Reactor seals
* E. Valves leaking
* F. Opening reactor heads for flushing
* G. Flushing reactors
* H. Cleaning reactors
* I. Cleaning build up from valves, lines, etc.
J. Maintenance on various equipment
K. Airing out equipment in preparation for entry
L. Operator errors
* M. Plugged lines resulting in gasket failure
N. Ventilation of reactors during flushing operation (vapors discharged on roof)
* O. Airing out vessels containing poorly degassed material as a result of plugged discharge line, set up, etc.
P. Purging of reactors prior to charging (vapors discharged on roof)

III. POLYMERIZATION BUILDING - STRIPPER LEVEL

* A. Sampling of unstripped suspension resin batches
* B. Pump seals, other process equipment leakage, etc.
C. Leaking valves
D. Leaking gaskets at pipe flanges
* E. Airing out reactors for cleaning and during cleaning
* F. Plugged lines resulting in gasket failure
* G. Spills resulting from unplugging of stopped lines
H. Operator errors
I. Purging of stripping vessels (vapors discharged on roof)
J. Maintenance work on pumps, other process equipment, cleaning discharge valves, e

IV. POLYMERIZATION BUILDING - PUMP OUT LEVEL (RELIEF AREA)

* A. Screening operation to remove coarse chunks of resin
B. Leaking pump seals
* C. Compressor leakage
D. Leaking pipe flanges resulting in spills
* E. Open vibrating screens
F. Leaks in closed screening operation
* G. Drains from top two floors
* H. Process water containing dissolved vinyl chloride discharging inside building.
* I. Draining of fo traps on compressors
* J. Draining water off the condensed recovered vinyl chloride
K. Moving screen overflow outside building and dumping drums

V. BLEND TANK AREA (WORK-IN-PROCESS STORAGE)

A. Monomer evolution during storage
* B. Flushing blend tanks
C. Leaks (pump seals, hoses, pipe flanges)

VI. SPRAY DRYING OPERATION

A. Spray dryer exhaust air (200 to 500 ppm)
B. Latex leaks from pump seals, pipe flanges
* C. Screening operation prior to atomization
D. Any operation involving finished resin or where dried resin accumulates. Dried resin contains approximately 10 ppm residual monomer.

1. Bagging
2. Housekeeping
3. Dried product screening
4. Changing dust collector bags
5. Cleaning equipment

VII. ROTARY DRYING OPERATION

A. Rotary dryer exhaust air (approximately 50 ppm)
B. Leaks from pump seals, pipe flanges
C. Centrifuge liquid discharge (effluent)
D. Any operation involving handling or storage of finished resin or where dried resin accumulates. Dried resin generally contains less than 100 ppm for the porous types, less than 500 ppm for the high bulk density types, and as high as 3000 ppm for two specialty types.

1. Bagging
2. Housekeeping
3. Dried product screening
4. Changing dust collector bags
5. Cleaning equipment
6. Pneumatic transfer of resin to storage or into bulk trucks and rail cars
7. Maintenance operations in areas where large masses of resin are stored, primarily silos.

VIII. WAREHOUSE AREAS

A. Any area where resin is stored in a manner that restricts air circulation

1. Plastic shrouded pallets
2. Resin in sealed drums or boxes, etc.
3. Resin in simi-bulk containers (metal tote bins, etc.)

B. There are low, but measurable, levels of vinyl chloride wherever resin is stored in bags (from gradual evolution of residual vinyl chloride)

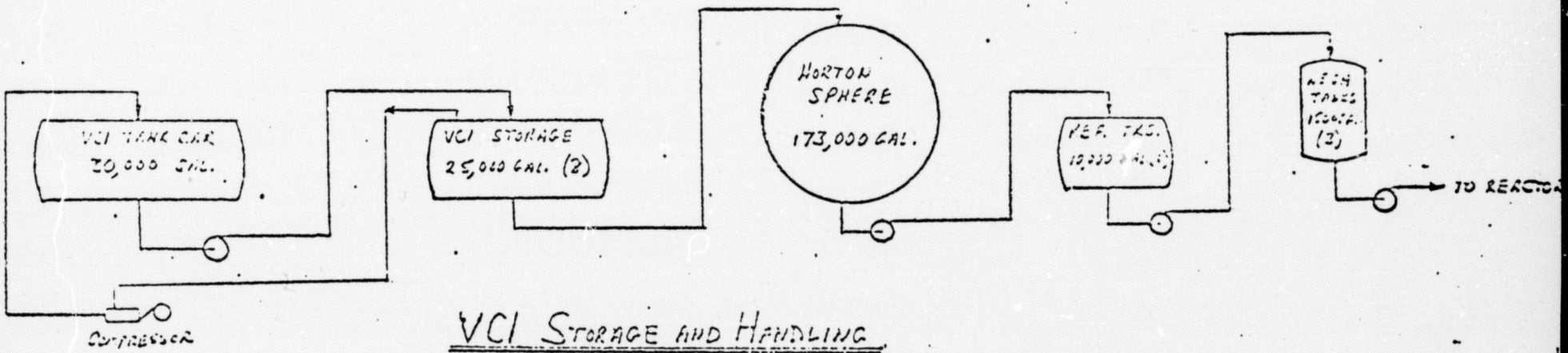
IX. LAB AREAS

A. Testing of finished resin
* B. Testing of resin slurry prior to drying (suspension resins)
* C. Testing of monomers in Control Lab and Analytical Lab

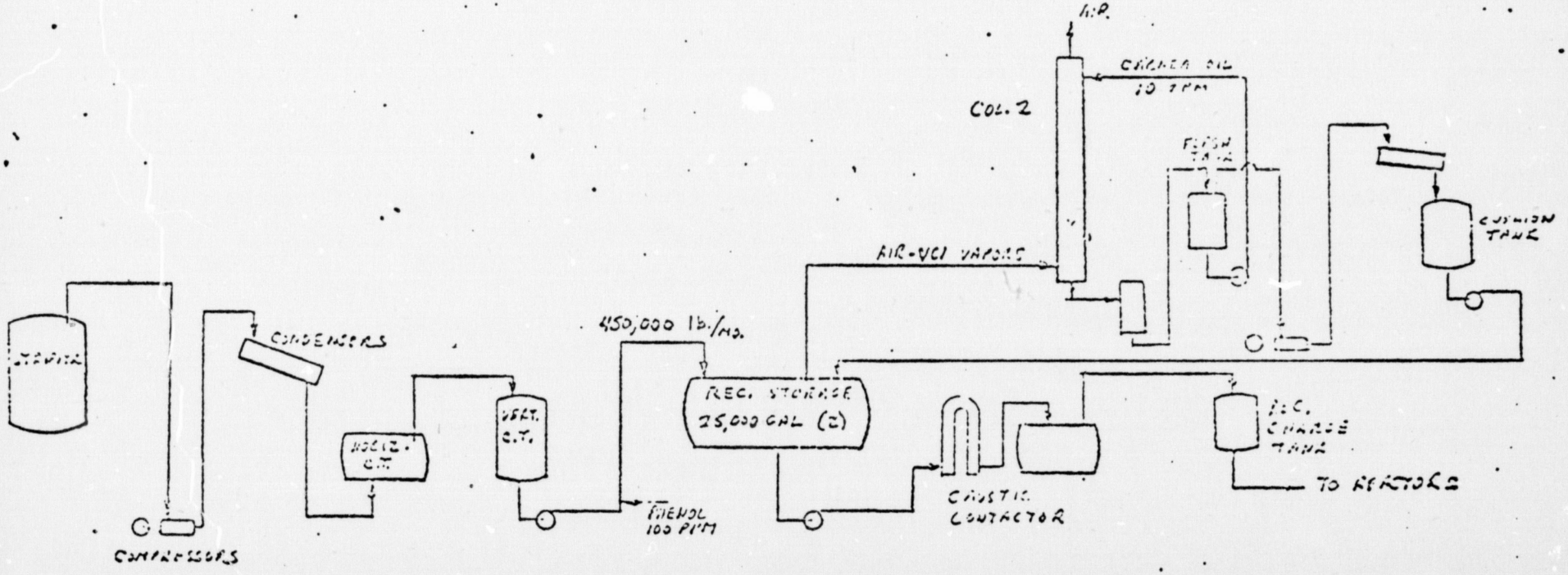
R. W. ARNOLD
FACTORY MANAGER
CHEMICAL PLANT

RWA/bjs
5/30/74

1604



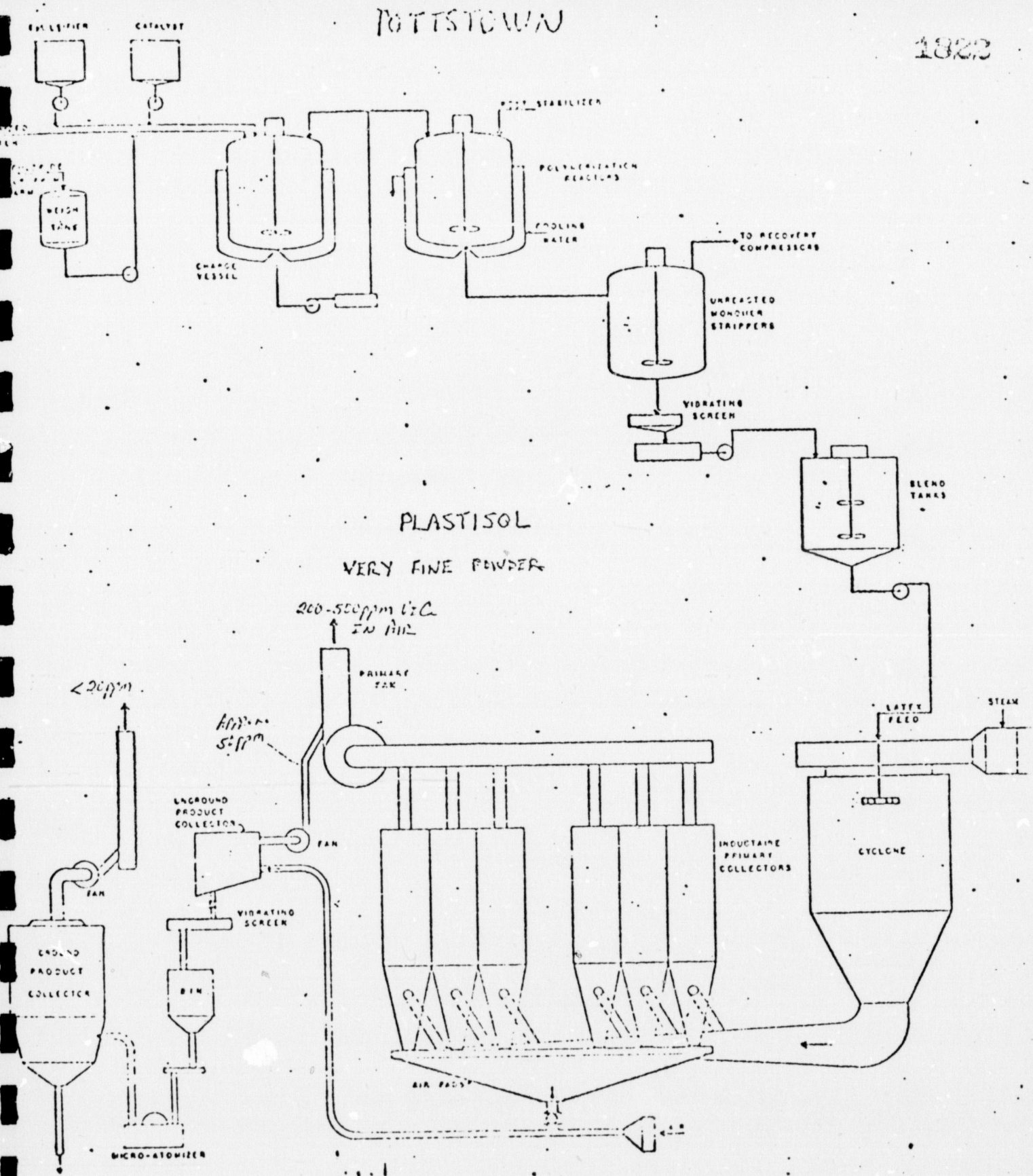
VCI Storage and Handling



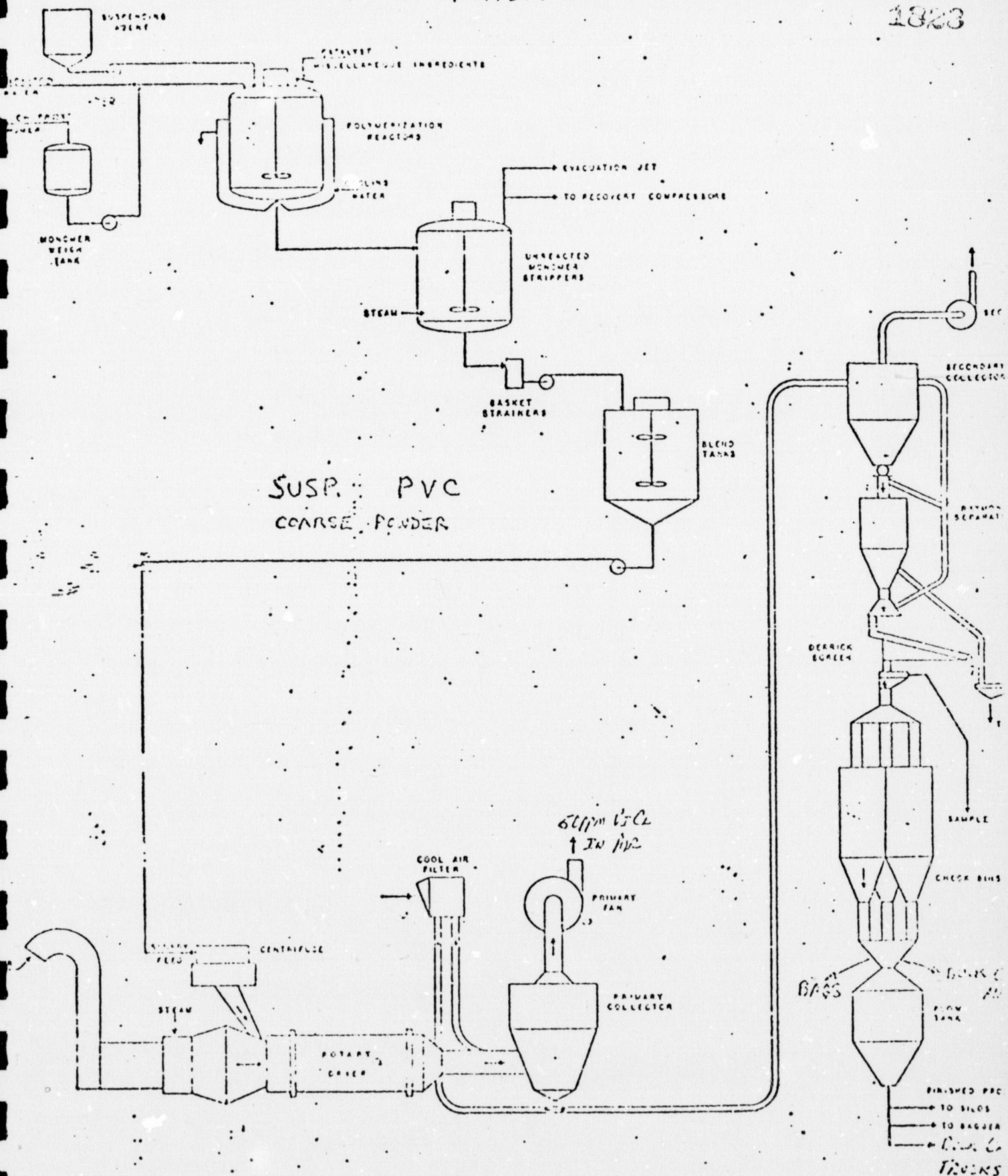
Recycle VCI Storage Handling

POTTSTOWN

1823



POLYVINYLCHLORIDE DISPERSION RESINS MANUFACTURE
FLOW DIAGRAM



POLYVINYLCHLORIDE RESINS MANUFACTURE
FLOW DIAGRAM

Firestone

INTEROFFICE

DATE MAY 31, 1974

TO MR. C. J. KLEINERT

FROM F. F. HOY

REFERRING TO LETTER OF

SUBJECT Evaluation of Impact on Perryville Plant of Proposed Permanent Standard for VCM Exposure Control at Various Ceiling Values

Attached is the information and comment gathered by the staff at the Perryville Plant on the above subject. This is our best estimate within the short time allowed. The proposed changes, cost data and conclusions are believed to be substantially accurate, but the result should be viewed with consideration of the limitations imposed by the time requirements.

Although we have sought to anticipate all necessary design, equipment and process changes which we believe are required in attempting to reach the four exposure levels contemplated by our study, we cannot assure that the proposed modifications would result in achievement of the contemplated levels. We have employed the most advanced engineering technologies and system designs presently known or anticipated in our study, but there are so many complex engineering factors involved it cannot be predicted whether any exposure level below 50 PPM can be reached until after the equipment has been installed and the design changes accomplished. However, in the judgment of our staff, it is technologically impossible to meet the non-detectable exposure level required by the proposed standard through engineering and technological means regardless of the amount of capital expenditures that might be made to improve and upgrade our plant.

The following paragraphs summarize our positions very briefly for an overview. All of the comments and details in the accompanying pages and tabulations are of critical importance in interpreting this summary.

1. Work Rules

The work rules which form part of the proposed permanent standard make operation under the rules virtually impractical, extremely expensive and reduce productivity. They contain the potential for frequent disruptions in the operation and make for unsafe operation. The work rules deserve as much concern as the ceiling values.

A reduction of work rules to those that have practical value would greatly lower operating costs and personnel required at all levels of ceiling value. It would be necessary to eliminate space suits, mandatory showers, mandatory changing of clothes. It would

M213A

be necessary to modify rules covering medical surveillance and reporting after exposures to apply only to larger exposures than presently specified. It would be necessary to exclude areas where likelihood of exposure is small despite theoretical possibilities.

2. 0-1 PPM Ceiling

We would not recommend operating the plant under a 0-1 PPM ceiling. It would be prohibitively expensive and despite the extensive and resulting capital changes, the plant would not meet the standard a major part of the time. Air mask and space suit operations would be required much of the time. Production would be drastically curtailed. The likelihood of ever getting out of air masks and space suits without completely rebuilding the plant is small. We have come up with a capital estimate of $18,000,000 for Perryville in an attempt to try to achieve the proposed level. These estimates are believed to be low. Some consideration to emissions is given but the estimates do not fully anticipate strict rules by EPA. That would be substantial additional cost.

3. 10 PPM TWA - 15 PPM Ceiling

We also have serious reservations about our ability of being able to operate the plant under a 10 PPM TWA - 15 PPM ceiling. Although the capital costs are lower at $5,500,000, much of the high operating cost and production penalties remain. The capital cost estimate may be low and does not anticipate strict EPA rules. At a 15 PPM ceiling the work rules are only slightly less costly. In fact, at all levels, the ceiling value will be the controlling factor in determining the capital costs resulting from required design and engineering changes unless the ceiling value is set at ten times TWA value. Even at these levels we seriously doubt that we would be able to avoid frequent use of air masks and space suits.

4. 25 PPM TWA - 40 PPM Ceiling

The plant could operate at the above standard but at greatly increased conversion costs. Again, the ceiling value is controlling. Capital costs to attempt to meet this level are estimated to be $4,500,000 but do not cover extremely strict EPA rules. The work rules greatly increase the number of people needed and operating costs.

5. 50 PPM Ceiling As A Permanent Standard

The plant could operate at the above standard but again only at greatly increased conversion costs. The difference between this and the temporary standard is the imposition of the work rules with the permanent standard. Required capital expenditures are estimated to be $2,800,000. However, we are rather certain this amount is too low and that the actual amount would be closer to $4,300,000 estimated for the 25 PPM TWA - 40 PPM ceiling. We believe in the haste of this preparation some capital items listed to cover a 40 PPM ceiling have been omitted in covering the 50 PPM ceiling along with work rules.

F. F. HOY
PLANT MANAGER

TABLE OF CONTENTS

I. PLANT I

A. Description of Present Process

B. Sources of Vinyl Chloride to Ambient Air in Plant

C. Summary Impact Statement

D. Capitalization Impact

E. Manpower Impact

1. Total Staffing

2. People Required to Operate New Equipment

3. People Required Because of New Work Rules

4. Discussion of Work Rules

5. Safety Aspects of Work Rules

F. Productivity Impact

G. Energy Impact

II. PLANT II

A. Summary of Capitalization and Operational Impact

B. Capitalization Impact

C. Manpower Impact

D. Operating Cost Impact

IMPACT STATEMENT
OF
PROPOSED VCM EXPOSURE STANDARDS
FOR
PLANT I

PVC PROCESS DESCRIPTION

GENERAL

Vinyl Chloride (VC) is a clear, waterlike liquid that boils at 7°F. Liquid VC, therefore, exerts pressure for all handling conditions above 7°F. Vinyl Chloride exerts 40 pounds pressure per square inch at room temperature.

A polyvinylchloride (PVC) reactor is a 4-6000 gallon, glass-lined, agitated tank with an outer jacket or shell where cooling water or steam may be circulated to cool or heat the vessels contents as required. The reactor is the vessel in which the reaction of VC to become PVC takes place.

After a number of batches, brittle chunks of PVC adhere to the walls of a reactor. It is necessary to remove these chunks because they will plug reactor openings and contaminate the product if left in the reactor. Curently men enter the reactors and clean them manually using hammers, chisels, and brushes.

RECEIVING AND STORAGE

Vinyl Chloride is received, as a liquid in railcars of 130,000 to 220,000 pound capacities.

The VC is unloaded into any one of three 80,000 gallon storage tanks using hoses and a compressor. Vapors are drawn from the storage tank and pushed into the railroad car, the higher pressure in the car pushes the VC into the tank. Once a car is emptied the compressor is reversed and most of the vapors in the car are drawn back into the storage tank. Once emptied, the car is resealed and shipped back to our supplier to be refilled. Normally, two to four cars are unloaded per day.

REACTION AND PROCESS

The VC is pumped from storage to a weigh tank where the VC in a batch is measured and then pumped into a reactor along with the other ingredients.

About two pounds of water are put in a batch for every pound of VC. This water keeps the batch from getting too thick to handle and helps to remove the heat given off by the reaction.

Once all of the ingredients have been charged to a reactor the batch is heated to a specific reaction temperature (110-150°F).

After reaching this temperature, the reaction of VC to PVC begins and the batch must be cooled to remove the heat given off by the reaction. The reaction proceeds until about 90% of the VC is converted to PVC and the reaction slows.

After the reaction has stopped, the batch is pressured into another agitated vessel called a stripper. In the stripper, steam and a vacuum pump are used to distill off most of the VC left unreacted. This VC is then condensed and recovered to be reused.

Because the VC is mixed so well into the PVC resin formed, it is impossible to remove all of the unreacted VC in the stripper, small amounts (less than 1%) remain in the resin after the strippers.

The mixture of granular PVC in water is called a slurry. After being stripped it resembles white sand in water, similarly it will settle if it isn't stirred or agitated.

The slurry is pumped from the strippers to agitated slurry tanks where it is stored until drying.

The first step of drying is to centrifuge the slurry. This separates it into water and a wet powder. The water is discarded and the wet resin powder is fed into a dryer.

The dryer is a standard, rotary dryer. It consists of a long tube that continuously rotates while hot air is drawn through it. The resin is admitted at the same end as the air and flows with the air through the tube drying as it is pushed by the air. At the far end of the dryer tube, the resin is a dry, free flowing white powder similar to sugar.

During the drying process more of the unreacted VC comes off the resin, it is vented with the drying air to the atmosphere. Residual VC in the resin is less than 0.1% of the final product.

The resin from the dryer is conveyed by air in tubes to storage silos. We currently have 9 silos each of which can hold 290,000 pounds of resin powder.

The resin is conveyed by air from the silos to trucks, railcars and to our compounding operation. Trace amounts of VC are given off slowly from the resin while it is stored and shipped.

SOURCES OF VINYL CHLORIDE TO AMBIENT AIR IN PLANT

Please refer to Flow Diagrams. Items marked with * are areas of actual or potential exposure to 50 PPM vinyl chloride or higher that pose problems because of exposure frequency or high exposure level.

I. TANK FARM (VCM STORAGE)

A. Rail Car Unloading

1. Gasketing at hose connections
*2. Pump seals
*3. Compressors
4. Flanges at pipe joints
*5. Valves leaking
6. Venting pressure off hoses before disconnecting

B. Transfer Operations (From 30,000 gallon storage tanks, to weigh tanks)

1. Pipe flanges
*2. Pump Seals
*3. Valves leaking
*4. Compressors
*5. Airing out tanks for pressure inspection of cleaning

II. POLYMERIZATION BUILDING - REACTOR AND STRIPPER LEVEL

*A. Pump Seals
B. Flanged Pipe Joints or Vessel Connections
*C. Reactor and Stripper Heads
D. Reactor and Stripper Seals
*E. Valves Leaking
*F. Opening Reactor and Stripper Heads for Flushing
*G. Flushing Reactors and Strippers
*H. Cleaning Reactors and Strippers
*I. Cleaning Build Up from Valves, Lines, etc.
J. Maintenance on Various Equipment
K. Airing Out Equipment in Preparation for Entry
*L. Operator Errors
*M. Plugged Lines Resulting in Gasket Failure
N. Ventilation of Reactors during Flushing Operation (vapors discharged on roof)
*O. Airing Out Vessels Containing Poorly Degassed Material As a Result of Plugged Discharge Line, Pot Up, etc.
P. Purging of Reactors Prior to Charging (vapors discharged on roof)
Q. Purging of Stripping Vessels (vapors discharged on roof)

III. POLYMERIZATION BUILDING - PUMP OUT LEVEL (RELIEF AREA)

A. Leaking Pump Seals
*B. Compressor Leakage
C. Leaking Pipe Flanges Resulting in Spills
*D. Leaks in VCM Filtering Vessels
*E. Drains from Top Floor
*F. Reclaim Water Containing Dissolved Vinyl Chloride Discharging Inside Building
*G. Draining of Foam Traps on Compressors
*I. Draining Water Off the Condensed Recovered Vinyl Chloride
J. Moving Polymer Chips Outside Building and Dumping Drums
*K. Changing and Handling VCM Filters

IV. BLEND TANK AREA (WORK-IN-PROCESS STORAGE)

*A. Monomer Evolution During Storage
*B. Flushing Blend Tanks
C. Leaks (pump seals, hoses, pipe flanges)

V. ROTARY DRYING OPERATION

A. Rotary Dryer Exhaust Air
B. Leaks From Pump Seals, Pipe Flanges
C. Centrifuge Liquid Discharge (effluent)
D. Any Operation Involving Handling or Storage of Finished Resin or Where Dried Resin Accumulates. Dried Resin Contains Less Than 100 PPM And As High As 1000 PPM, the Average being Around 400 PPM.

1. Bagging
2. Housekeeping
3. Dried product screening
4. Changing dust collector bags
5. Cleaning equipment
6. Pneumatic transfer of resin to storage or into bulk trucks and rail cars.
7. Maintenance operations in areas where large masses of resin are stored, primarily silos.

VI. WAREHOUSE AREA

A. Any Area Where Resin is Stored in a Manner that Restricts Air Circulation

1. Plastic shrouded pallets
2. Resin and compound in sealed drums or boxes, etc.
3. Resin and compound in semi-bulk containers (metal tote bins, etc.)

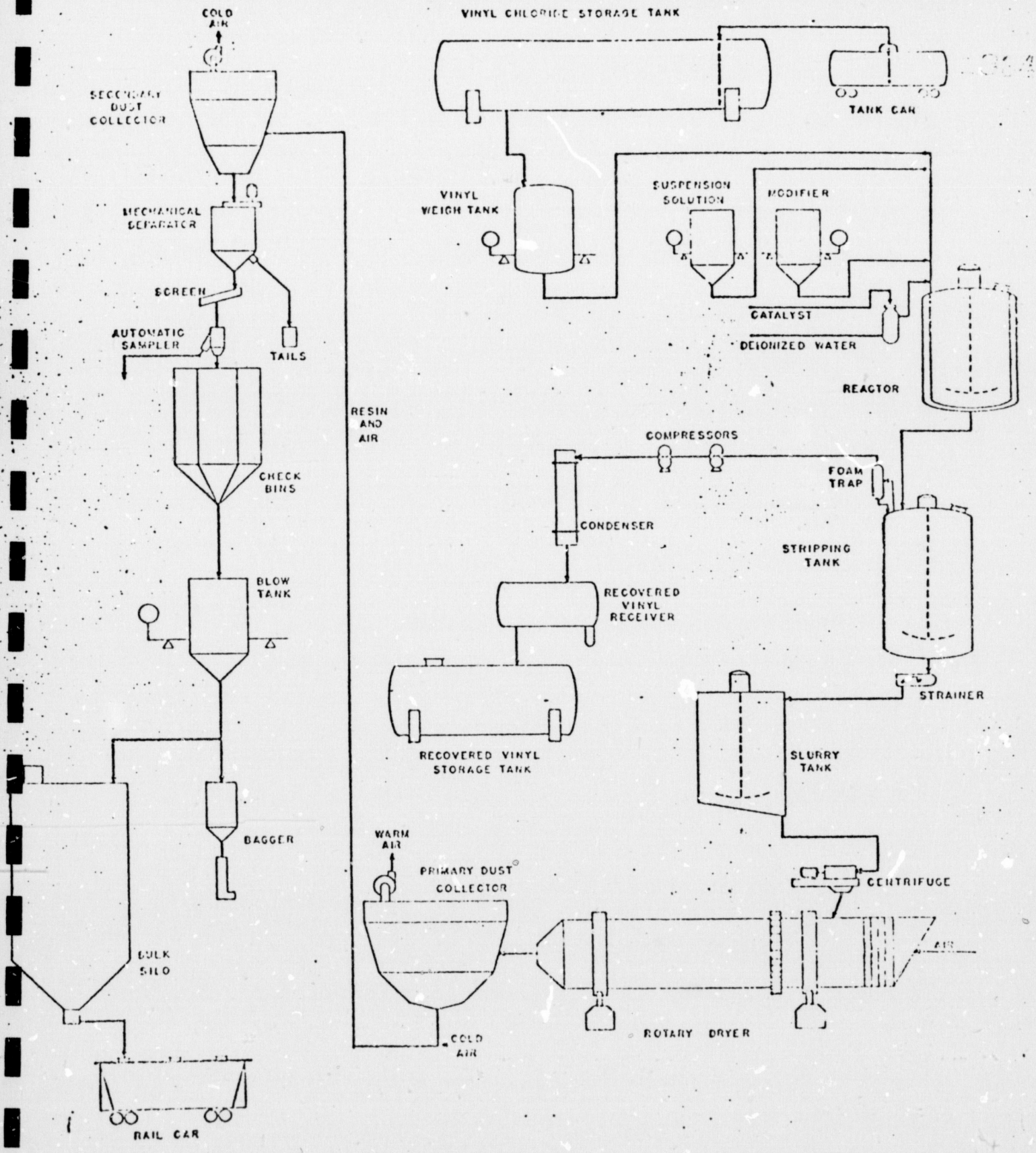
B. There are Low, but Measurable, Levels of Vinyl Chloride Wherever Resin is Stored in Bags (from gradual evolution of residual vinyl chloride)

VII. LAB AREA

A. Testing of Finished Resin
* B. Testing of Resin Slurry Prior to Drying (Suspension Resins)
C. Testing of VCM
D. Testing of Compound (Dry Blends and Finished Product)

VIII. COMPOUND AREA

A. Blending and Mixing Operations



POLYVINYLCHLORIDE RESIN MANUFACTURE
FLOW DIAGRAM

SUMMARY OF TOTAL IMPACT OF THE PROPOSED OSHA STANDARD
OF VINYL EXPOSURE AND LESS RESTRICTIVE ALTERNATIVE FOR PLANT #1

Capital cost estimates have been prepared for equipment required to comply with several levels of VCM TWA and ceiling values including the proposed work rules. This equipment falls mainly in the categories of improved VCM recovery, improved reactor cleaning methods, improvements to ventilation and exhaust systems at the higher allowable VCM levels. As the standard becomes tighter, additional money is required for more sophisticated equipment and equipment to control exposure in new areas. At the levels approaching zero additional money is required to remove personnel from some areas and replace them with automated equipment. At this point technical feasibility becomes doubtful and the capital estimates nearly academic

The design is to contain all VCM possible inside vessels and pipes and then carry what cannot be contained away from personnel.

	ALLOWABLE EXPOSURE	50 PPM	40 PPM MAX 25 PPM TWA	15 PPM MAX 10 PPM TWA	NON DETECTABL
1	Capital Cost	$1,771,400	$2,274,600	$3,530,900	$12,670,00
2	Additional Purchased Utilities Operating Cost	$ 14,253	$ 18,797	$ 39,315	$ 92,26
3	Additional Operating Personnel Total above present staffing including premium time.	93	95	111.5	16
4	Percentage Decrease in Production*				
	Resin	3-5%	3-5%	5-10%	10-25
	Compound	3-5%	3-5%	3-5%	10-15

*This does not include downtime to "retool" the plant. This time is estimated between 1 & 2 years for the O-1 Standard.

50 PPM CEILING
EQUIPMENT COST INSTALLED EXISTING HENRYVILLE PVC PLANT

		COST
A.	Continuous Monitoring	$ 103,400.00
B.	Purge Header (Large) to Reactors	35,200.00
C.	Vinyl Recovery Header	38,000.00
D.	Additional Recovery Capacity for Purging Reactors	189,000.00
E.	20,000 Gallon Surge Vessel with Agitator and Transfer Pump	114,000.00
F.	Convert F-449 to Stripper	32,900.00
G.	Slurry Cooler	28,600.00
H.	Insulate Strippers (Four)	34,000.00
I.	High Pressure Water Cleaning for Reactors	159,600.00
J.	Improve Slurry Tank Ventilation	12,700.00
K.	VCM Unloading Hose Purge System	19,300.00
L.	Unloading Compressor Ventilation	15,000.00
M.	Poly Building Fan Alarms	35,000.00
N.	Building Addition for Recovery	45,000.00
O.	Vent Dryer Exhausts to Tower Roof Extension of the Dryer exhaust ducts approximately 15' higher, to above the compound tower plus new blower to handle increased ΔP (pull fans on top of finishing tower)	53,500.00
P.	Recovery System Blowdown Control	9,300.00
Q.	Insulate Stripper Domes and Header Insulate the stripper domes and header to allow safe steam purging	4,000.00
R.	Install High Pressure Alarms on 15 Other Reactors Provide high pressure alarms for the reactors that can be set by the operators at the front of the control panel. 15 Moore controllers are required.	7,500.00

50 PPM CEILING

EQUIPMENT COST INSTALLED EXISTING PERRYVILLE PVC PLANT 1937

		Cost
Additional VCM Filter One additional vinyl filter placed in parallel with the present filter piped for a warm water purge to stripper F-423. Water should be metered from the charge water tank.	$	5,700.00
Vacuum Pump to Replace Steam Jet Replacement of the steam jet with a vacuum pump capable of 400 ACFM at 28" high. Discharge to a high stack.		21,600.00
Additional Air Compressor A screw type air compressor to provide 80-100psig air for two 6" MSA air horns. In addition a 2" air header should be installed under the 1st floor.		49,700.00
Double Poly Building Unit Heating Double the poly building unit heaters. Design to handle 20 air changes per hour instead of 10. From C&R design 7.4mm BTU/hr additional.		21,500.00
Stack Vents to Surge Tank and Recovery System A system of vent lines that tie in the relief lines of all reactors, weight tank, recovery system reliefs and cushion tank reliefs to a header that leads to a large collection tank, possibly floating roof. A recovery system will tie into the tank to recover vented VCM. Pipes and tank will be designed for internal water flush. As a design starting point - the system should handle 10,000# of VCM in 10 minutes. VCM and flow sensors will be provided to locate sources of venting and to start the recovery system. Recovery system would operate at 0psig suction 40psig discharge refrigerated water cooling with 0°F brine cooled vent condenser and refrigeration. All refrigeration should have auxillary power. Under operation of 0-10psig the tank accumulator would be in the order of 30,000ft and located south of the poly building.		246,500.00

90 PPM CEILING
EQUIPMENT COST INSTALLED EXISTING PERRYVILLE PVC PLANT 1333

	Cost
Showers, Change Rooms, and Lunchroom An additional shower and change room located by the lab. At one end lockers will be provided for all clock card employees for work clothes, in the 25 shower stalls and at the other end a street clothes locker room. A plant laundry room and lunch room is also included (40 x 60).	$ 80,000.00
Y. Collector for Compound Blender Airing	12,400.00
Subtotal	$ 1,400,400.00
10% Engineering	140,000.00
Subtotal	$ 1,540,400.00
15% Contingency	231,000.00
Project Cost	$ 1,771,400.00

40 PPM CEILING WITH 25 PPM TWA
EQUIPMENT COST INSTALLED EXISTING PENNYVILLE PVC PLANT

	Cost
All Equipment Associated with 50 PPM	$ 1,4[illegible]00.00
Charge System for Suspending Agent	33,000.00
Carbon Absorption System with Surge	346,500.00
Tie Relief Lines and Strainers to F-438 Vacuum Sources	3,700.00
Blower to Air Pads in Silos	17,000.00
Subtotal	$ 1,800,600.00
10% Engineering	180,000.00
Subtotal	$ 1,980,600.00
15% Contingency	294,000.00
Project Cost	$ 2,274,600.00

15 PPM CEILING WITH 10 PPM TWA
EQUIPMENT COST INSTALLED EXISTING PERRYVILLE PVC PLANT

		Cost
A.	All Equipment Associated with 40 PPM Ceiling with 25 TWA...less improved slurry ventilation	$ 1,800,000.00
	less additional VCM filter	12,700.00
	Subtotal	5,700.00
		$ 1,781,600.00
B.	Totally Automatic VCM Filters	15,000.00
C.	Seal, Purge Blend Tanks and Filter with Carbon Absorption and Flush Remotely	186,000.00
D.	Two Strippers Complete in 20 x 40 Building Addition plus Double Steam Flow to Four Existing Units.	184,000.00
E.	Sealed Silo Unloading Hose with Digital Weight Readout and Control at Each Silo	72,700.00
F.	Additional Seals on VCM Unloading Hoses	5,000.00
G.	Fan at VCM Unloading Racks	15,000.00
H.	Reactor Cleaning Scrap Baskets with Air Purge	1,000.00
I.	1000# per Day PVC Incinerator (Common/E-Latex)	250,000.00
J.	Automate Stripper Pumpout and Dryer Feed from Blend Tanks	150,000.00
K.	Double Ventilation at Compound Mixer, Mill and Lab Mills	9,000.00
	Subtotal	$ 2,669,900.00
	10% Engineering	400,500.00
	Subtotal	$ 3,070,400.00
	15% Contingency	460,500.00
	Project Total	$ 3,530,900.00

0-1 PPM CEILING - NO DETECTABLE LEVEL
EQUIPMENT COST INSTALLED EXISTING PERRYVILLE PVC PLANT

		COST
A.	All Equipment Associated with 15-10 Level	$ 2,669,900.00
	Less, Insulation of Strippers	34,000.00
	High Pressure H_2O Cleaning	159,600.00
	Poly Building Fan Alarms	35,000.00
	Vent Dryer Exhaust to Tower Roof	53,500.00
	Insulate Stripper Domes and Headers	4,000.00
	Double Poly Building Unit Heaters	21,500.00
	Dust Collector Fan Compound Blender	12,400.00
	Fan at VCM Rack	15,000.00
	Reactor Cleaning Buckets	1,000.00
	Subtotal	$ 2,333,200.00
B.	Weld All VCM Lines Where Feasible Where routine maintenance and cleaning does not require breaking of flanged VCM, recovery system and slurry pipe lines these should be welded - this will probably apply to 25-50% of the flanges exposed.	40,000.00
C.	Provide Seals for VCM Line Flanges that Can Not be welded. The rest of the exposed flanges should be provided with a clamp on seal cover.	50,000.00
D.	New Sealless VCM Pumps (Four) Replace existing seal type pumps with sealless pumps.	14,000.00
E.	Reactor Solvent Cleaning System including tanks, headers, feed pipes, solvent recovery, controls and incineration of solids.	500,000.00
F.	Seal-Off Make-Up and Control Room Area Seal off the second floor solution makeup area and control room from the rest of the poly building, providing access doors, windows to the reactor area, LV monitors where required. Pressure up area slightly with 20 Airchanges per hour of fresh air, monitored and taken from south of lab.	20,000.00

0-1 PPM CEILING - NO DETECTABLE LEVEL
EQUIPMENT COST INSTALLED EXISTING PLAQUEMINE PVC PLANT

G.	Mechanize and Computerize Poly Building To reduce entry into the poly area to a minimum. Charging/dropping/stripping/ pumpout and reactor cleaning should be mechanized and computerized.	$2,000,000.00
H.	Recirculate Air in Poly Building and Pull-Off Steam and Run Through Carbon Absorption Unit. Air in the Poly area will be between 1-10 PPM. Discharge to the atmosphere would contaminate air north of the building possible areas in compound. Therefore, this area must be sealed (vented only in emergencies) and the air circulated through carbon or oil absorption at 10 Air changes per hour. This amounts to 100,000 CFM unit to maintain <10 PPM in building.	500,000.00
I.	Stripping Column for Recirculating Blowdown Water 30 GPM High temperature stripping column to strip off the 1-15 PPM by water soluble VCM in blowdown water taken from poly after the vapor/liquid separation. Possibly a small amount of potassium persulfate could be added as a water soluble catalyst treatment.	50,000.00
J.	Additional Lab Hoods and Oil Column There will be no lab testing of slurry but testing of resin will continue in hoods. Provide 10' of additional hood counter area plus air flow to provide 200 ft per minute away from technicians. Resin will be handled in closed metal containers. Mills, brabender, screens and other test areas will be hooded to provide 200 ft per minute air flow away from technicians.	20,000.00
K.	Increase Capacity of Drying Lines to provide additional heat and dwell time.	52,500.00

0-1 PPM - NO DETECTABLE LEVEL
EQUIPMENT COST INSTALLED INCLUDING LOUISVILLE PVC PLANT

		COST
L.	Close Dryer Loops at Primary Fans Close the air loop on the dryers and provide H_2O knockout and carbon absorption of VCM as proposed by Chemical Design. As an alternative, use Bartlett/Snow, type D, indirectly heated dryers with Nash recovery systems to knockout H_2O and recover VCM. Cost out both-choose the lowest costs based on both capital and operating cost.	$ 3,000,000.00
M.	Close Secondary Fan Loops The secondary air loop will have to be handled the same way our present dryer close the loop-LiCl to absorb moisture/carbon absorption for VCM only at 10,000 CFM. All equipment below the secondaries must be sealed including the derricks. Blow tank and check bin venting to carbon absorption and a stack. Air-veying and silo storage - air is assumed to have non-measurable amounts of VCM at this point.	500,000.00
N.	Mechanize Bagging Lines Compartmentize compound boxing and resin/compound bagging - mechanize bagging/palletizing and boxing so that empty bags go in one end and full ones come out the other.	250,000.00
O.	Isolate Warehouse and Provide Air Changes Compartmentize the warehouse. Increase air flow to 20 air changes per hour. Include increase in unit heaters. An alternative would be to eliminate bags and boxes and go to returnable tote bins with gate valves to top and bottom. These could be loaded on a "milk bottle" assembly line with no exposure and very little fancy equipment. Figure 1,000 totes - enough to handle 3.5mm/month product with 1 month turn-around, 3500#/tote.	30,500.00

O-1 PTH - NO PHYSICAL LEVEL
EQUIPMENT COST INSTALLED EXISTING PERRYVILLE PVC PLANT

		COST
P.	25MM#/Month Pallet Storage and Retreiving Mechanized and Computerized System Provide an automatic pallet storage and retrieval system, including racks for 2.5mm pounds of product.	400,000.00
Q.	Fresh Air Header - in 1st/2nd floor poly	50,000.00
R.	Add Cyclones between Dryers/Baghouse Install cyclones between dryers and primary baghouses.	200,000.00
	Subtotal	$ 10,010,000.00
	10% Engineering	1,000,000.00
	Subtotal	$ 11,010,000.00
	15% Contingency	1,650,000.00
	Project Total	$ 12,370,000.00

TOTAL STAFFING REQUIRED FOR THE VARIOUS PROPOSED STANDARDS

	50	40 /25	15/10	0-1
I. Present Staffing				
Line Production Supervision (salary)	5	5	5	5
Production (hourly)	62	62	62	62
Salary Office Staff	34	34	34	34
Maintenance Supervision (salary)	5	5	5	5
Maintenance (hourly)	27	27	27	27
I. Sub-Total	133	133	133	133
II. Additional People Required to Operate New Equipment				
Line Production Supervision	---	---	---	4
Production (hourly)	5	5	6	18
Salary Office Staff (Including Eng/Clerical)	---	---	3	6
Maintenance Supervision	---	---	1	2
Maintenance (hourly)	2	3	5	18
II. Sub-total	7	8	15	48
Total I. and II.	140	141	148	181

III. Additional Personnel Required Because of Work Rules

Adjustment:
1. Production and maintenance hourly and supervision increased 12.5% for hygiene
2. Total staff increased 5% for medical surveillance.

	50	40/25	15/10	0-1
II. (Continued)				
Line Production Supervision	.5	.5	.5	1
Production Hourly	21	21	22	20
Salary Office Staff	5.5	5.5	6	11.5
Maintenance Supervision	.5	.5	.5	1
Maintenance (hourly)	6	6	6	9
Sub-Total III.	33.5	33.5	35.0	42.5
Total I., II. and III.	173.5	174.5	183.0	223.5
IV. Total Staffing Adjustments				
1. Shower overtime .0625% indicated as increased staff for plant personnel excluding office staff.				
2. A 25% hazardous industry pay increase to get and maintain good people.				
Line Production Supervision	7.5	7.5	7.5	14
Production (hourly)	112	112	120	133
Salary Office Staff	53	53	58	68
Maintenance Supervision	7.5	7.5	9	11
Maintenance (hourly)	46	48	50	71
Total Adjusted Personnel	226	228	244.5	297

MAY 31, 1974

ESTIMATE OF ADDITIONAL PEOPLE REQUIRED TO [illegible]

1317

Key:
- Production
- Maintenance
- Salary

	50	40 /25	15/10	0-1
Continuous Monitoring	M-¼ P-0	M-¼ P-0	M-¼ P-0	M-¼ P-0
High Pressure Water Cleaning	M-¼ P-0	M-¼ P-0	M-¼ P-0	M-¼ P-0
Additional Recovery Equipment/Stripper	M-½ P-1	M-½ P-1	M-½ P-1	M-½ P-1
Additional VCM Unloading Equipment	M-0 P-0	M-0 P-0	M-0 P-0	M-0 P-0
Relief Vent System with Recovery	M-¼ P-0	M-¼ P-0	M-¼ P-0	M-¼ P-0
Additional Air Ventilating Equipment in Poly/Compound	M-¼ P-0	M-¼ P-0	M-¼ P-0	M-¼ P-0
Additional Compressors/ Filters & Other Misc. Equipment	M-¼ P-0	M-¼ P-0	M-¼ P-0	M-¼ P-0
Lunch, Laundry, Locker Room	P-4	P-4	P-4	P-4
Additional People Required to Handle 40 /25		M-½	M-½	M-½
Carbon Absorption System Vent Condenser				
Additional People Required to Handle 15/10			M-½ MS-1 P-½	M-½ MS-1 P-½
Additional Carbon Absorption Blend Tanks			-	-
Additional Stripping			-	-
Secondary Seal System CM Unloading			M-1 P-½	M-1 P-½
Sealed Unloading Hoses & Weigh-Out System				

	50	40 /55	15/10	0-1
Scrap Handling Basket			P-yes, included elsewhere	P-yes. (same.
Scrap Incinerator			M-1	M-1
Automatic Stripping & Dump-Out, Feed to Dryer			M-½	M-½
Additional People Required to Handle 0-1				
High pressure H_2O Cleaning				M-(¼)
Additional Ventilation Poly/Compound				M-(¼)
VCM Pipeling Maintenance				M-2 MS-1 P-8 PS-4
Reactor Solvent Cleaning				M-2 P-8
Mechanize & Computerize Poly Building				M-4 P-(4)
Additional Carbon Absorption Poly Bldg./Dryer				M-2 P-4
Mechanize Bagging/Boxing				M-2 P-(4)
Isolate & Mechanize/ Computerize the Wash. With Increased Ventilation				M-1 P-0
SUB-TOTALS				
Production - Hourly	5	5	6	18
Maintenance - Hourly	2	3	5	18
Production Line Supervision	-	-	-	4

	50	40/25	15/10	0-1
SUB-TOTALS (cont'd)				
Maintenance Salary Supervision	-	-	1	2
Office Staff Engineers	-	-	2	4
Clerical	-	-	1	2
TOTALS	7	8	15	48

J. FOLEY
31/74

ESTIMATE OF ADDITIONAL PEOPLE NEEDED TO OPERATE THE PLANT
[illegible] THE NEW ROLL PROCESS AS THE PERMANENT STANDARD

This study includes estimates of both the number of additional people required as well as comments related to increased man-hour requirements per person and wage increases represented as an increase in man-hours at regular work time salary.

The study is taken by section of the proposed permanent standard and encompasses studies made by Mr. Tyson and Mr. Reighard.

	PRODUCTION & STAFF ENGINEERING			
	50	40/25	15/10	0-1
(e) Monitoring changes in personnel from level to level is related to difficulty in meeting the limit and increases in exposed personnel.				
Sample taking personnel	1	1	1	2 Salary
Sample Testing	1	1	1	2 Salary
Data record keeping and file including data from permanent monitoring system	1/2	1/2	1	1 Salary
Training instructor in VCM hazards and protection	1/2	1/2	1/2	1 Salary
In Plant Medical Surveillance A Doctor	---	---	---	1/2 Salary
Additional attention to pull down vinyl lines, monitoring, ventilating equipment, tagging and following other additional procedures will double work time in 5% of the jobs - to maintain about rate of repair	2	2	3	4 Maintenanc

	50	40/25	15/10	0-1
(o) (p) Medical surveillance & Records	1/2	1/2	1	1 Salary

Testing would be done by the local hospital. A doctor would probably have to spend some in plant time @ 0-1. This accounted for (e)

A costly aspect of this is the additional people plant wide to cover routine and emergency medical surveillance. Total staff would have to be increased 5% to cover people that were being checked over. The standard test would require a day to run plus transportation, time, and sometimes people.

Will account for further on in the calculations

People that did not want to work have the perfect excuse - a sniff or two of VCM

(g) (h) Respiratory Protection & Protective Clothing — 1 Salary

For maintenance and inventory of equipment. Initially this equipment will be the responsibility of the personnel assigned to the lunch, laundry and locker room. These people have been accounted for.

(i) Hygiene facilities - people accounted.

Hygiene practices would involve an additional 1 hour/regular day for every operating employee. This staff would have to be increased by 12.5% to cover the last shower of the day. Would add .333 hour overtime per man or 1/2 hour straight time equivalent (6.25 increase in wages)

Will account for further on in the calculations.

	50	40/25	15/10	0-1
(j) Emergency Situations				
Emergency procedures as well as regular operating procedures would have to be kept the best of order. Better update and coverage are required.	1/2	1/2	1/2	1 Salary
(l) Maintenance and Decontamination	8	8	8	4 Production
This would include spill cleanup, waste and scrap pickup and transport.				
Vessel entry with whole body suit less than 5% of maintenance is in vessels presently.			1	2 Maintenance
There would be more work of this nature as more equipment is required - work time would more than double under these conditions.				

GENERAL COMMENTS ON WORK PRACTICES REGULATIONS
OF PROPOSED PERMANENT STANDARD FOR VCM

The work practices contained in the proposed permanent standard are patterned after a standard for solid or liquid material. Some have very little relevance to protection from VCM because of its extremely volatile nature. Decontamination after contact with liquid or vapor VCM has no meaning. The liquid quickly evaporates upon release from a pressure vessel. The vapor dissipates in the air as any other gas. Neither the liquid nor gas will cling to clothing, skin or equipment.

Decontamination after contact with the resin is unnecessary. While the resin may cling to clothing or skin, it is no more harmful than any other powder. The minute quantity of VCM that may be residual in the resin will slowly come to the surface but then immediately pass off as a gas. It will not cling to the skin or clothing. The amount of VCM in the resin on a person thoroughly dusted with resin would not be detectable as it leaves the resin and dissipates into the atmosphere.

Those work practice rules that provide no protection or negligible protection should be removed from the standard. Some of them are very restrictive on either the employee or employer. In fact the total work practice package if it remains may drive domestic PVC producers out of the market regardless of any adjustments in the TWA or ceiling levels. The following comments on specific sections of the rules apply regardless of the TWA and ceiling values finally adopted. Of course, if the exposure level of zero is adopted, the work practices will not matter since no plant will operate.

1. Section (h) (1) requires that employees in regulated areas wear protective full body clothing, footwear and gloves. While work clothes are provided in some plants as a convenience and gloves are provided for rough or dirty work in most plants, these precautions are unnecessary for protection against VCM vapor and PVC resin as discussed in the beginning of this part of the presentation. Contact with liquid VCM almost never occurs because it quickly evaporates when not under pressure leaving no VCM residue.

   It is not reasonable to dictate to employees what they must wear unless a good reason can be shown for it. And it is almost impossible for management to enforce a rule that cannot be shown to have benefit.

Certainly gloves will be objected to for most jobs. Operators will find it difficult to operate controls and keep records while wearing gloves. Maintenance men, particularly instrument and electrical repairmen will find it impossible to do their work properly.

2. Section (h) (2) has to do with areas where polyvinyl chloride powder containing detectable levels of VCM is handled. It is very difficult to strip all the VCM out of resin. It diffuses from the resin very slowly and it may be weeks until all is gone. The residual VCM is detectable in the resin down to very low levels. If the PVC resin is confined in a closed container, the small amount of residual VCM will slowly diffuse from the resin and if the air space in the container is small may create an atmosphere inside the container of 50 PPM or more VCM. The actual amount of VCM gas will be small and once the container is open would be hard to find as it escapes into the atmosphere. Nevertheless, it could be argued that the VCM is detectable since a probe inserted in the container could measure it. The point is that all areas where PVC resin is handled could fall under the rule by strict interpretation while at the same time contact with VCM from the resin in many of these areas would be nil. The effect would be to unnecessarily broaden the area of control and make a nightmare of implementation. Carried to extremes by an over-zealous individual, control could be extended to cover the truck that hauls the resin, the terminal where it is parked, the customer's lab where a sample container could be opened, the office of a purchasing agent where a sample might be inspected. One could argue that the truck driver should wear protective clothing and gloves and change out of them whenever he leaves his truck.

These rules would not be modified by a change in the allowable ceiling to 15 or 30 PPM since as pointed out, minute quantities of VCM in the resin could produce an atmosphere inside a filled and sealed trunk or other container of 50 PPM VCM or more. The chance of contact with such concentration from these sources is small. Nevertheless, by diligent effort, such concentrations could be measured.

A modification to eliminate these loose ends would be one that would exempt areas from regulation wherever resin used or handled has a residual VCM concentration below a certain level. Monitoring and control of residual VCM in the resin could then be made a requirement. At

whatever point in the process this level was not exceeded, regulation would cease. If resin from the dryer always measured below that level, packaging, storage and loading areas would be non-regulated. Processors of the resin would be non-regulated.

The residual level chosen should be one at which it could be shown that handling and processing of the resin would not cause significant exposure to VCM as compared with the intent of TWA and ceiling values adopted.

3. Section (3) (i) Head coverings are not necessary for the same reason as given in the preceding section. Any VCM diffusing from resin will immediately pass off as a gas leaving insignificant skin contact. The standard is to protect against VCM. Protection against dust exposure as such is covered in other rules.

4. Section (2) (i) This regulation requires that protective clothing be removed whenever leaving areas where resin is handled. There is no protective value to removing clothing worn in these areas for the reasons already given. In the case of solid or liquid carcinogens, the dust or the liquid on the employees' clothing is the carcinogen itself or is made up in large parts of the carcinogen. In the case of PVC resin, the suspected agent VCM will be a very small part of the dust and this will dissipate into the air in nearly undetectable concentrations. Employee contact with VCM from dust on clothing is nil.

This regulation would be an unbelievable burden to employees and employer. PVC plants because of their construction are not air conditioned. Polymerization buildings must be constructed with thin walls designed to relieve under internal pressure. Protective clothing cannot be worn as an extra garment part of the year. Therefore, employees would be forced to go to the locker room to change clothes before going for a break or for lunch and to go there and change back into protective clothing before returning to work. Maintenance personnel would have to change each time they enter and leave a regulated area. Management, on the other hand, to minimize the lost time resulting and to force compliance would have to strictly supervise breaks resulting in a concentration camp atmosphere. Depending on the location of the change room and break area, the rule might easily cost 1 to 2 hours per day average per man and much more in the case of those who wished to abuse it.

5. Section (2) (iii) Mandatory showers for employees in resin handling areas. There is no protective value from exposure to VCM in taking showers for the reasons already given under

protective clothing. Protection from dust as such is covered by other regulations. Most PVC manufacturers provide showers as a convenience to be enjoyed at the option of the employee. Making them mandatory would be an unnecessary invasion of personal prerogatives.

It would impose a substantial burden on employers as well. Presently optional showers are taken on the employee's own time after his shift or during the last few minutes of his shift. The optional nature of this convenience encourages him to hurry through to allow his fellow employees to get theirs in without great delay. However, if showers are required, the time will have to be allotted for them just as protective clothing is specified at no cost to the employee. Showers then take on a new dimension. An employee may not go back into the area to allow another employee to take his shower. Policing of showers to see that all take them, to see that all can get through by the end of the shift, claims for overtime, arguments over who goes to the shower first, covering jobs while employees shower, all of these things will probably result in employers negotiating a half hour or hour overtime per day for all employees to cover the mandatory showers.

6. Section (3) (i) Storage or consumption of food prohibited in regulated areas. While this is not a rule of particular difficulty, it will be found inconvenient by employees and has very little protective value. None of the researchers of the problem has suggested that the victims of angiosarcoma ate the VCM.

7. Section (j) (2) (ii) Medical surveillance within 24 hours for all employees exposed to VCM. Since all employees are already required to have annual or semi-annual medical surveillance with follow-ups in case of unusual test results, this added requirement has no real value. It has the potential of flagrant abuse by troublesome employees and puts the Company completely at their mercy. A minor incident might require that half or all of the Poly building crew report to the physician's office. Safety of the plant might go completely abegging while unqualified operators covered the jobs vacated by regular employees who were out of the plant beginning their medical surveillance.

8. Section (j) (2) (iii) Shower required after contact with liquid VCM. Accidental contact with liquid VCM is very unlikely, since the liquid volatilizes immediately on release. Should such contact occur, the liquid would all evaporate in seconds leaving no VCM residue. Therefore, a shower would have no protective value.

However, this is another rule susceptible to potential abuse and leaving the employer at the mercy of the troublesome employee. A recalcitrant employee could go for a shower any time he pleased by claiming or arranging an exposure. And, of course, this would trigger the medical surveillance-incident report procedure.

9. Section (j) (2) (iv) Report of incident to OSHA and to employee. Because of the volatile nature of VCM, it exerts a high pressure on containing equipment. Any leak quickly spreads the gas invisibly into the atmosphere. Also, however, because of its gaseous nature, it is quickly swept out of the building by the special exhaust fans. Therefore, any leak is likely to cause an exposure but most exposures are likely to be brief. This is a situation unlike that encountered with spills of liquid or solids where they can be seen and avoided, or where the employee may be splashed with direct contact.

Because of the likelihood of numerous brief exposures, the reporting of every incident to OSHA and to the employees with all the details required would impose a severe burden on the employer.

10. Section (k) Signs and Labels. In this and other sections, reference is made to resins or waste materials containing detectable levels of VCM or emitting detectable levels of VCM. Since no plant would continue to operate under the proposed permanent standard, the wording here is academic. However, should a TWA and ceiling value be established that would allow the PVC industry to continue to operate, this wording would require careful consideration. As discussed under section (h)(2) with residual VCM levels in resin below 1.0 PPM it is possible in closed, full containers to develop over 50 PPM VCM in the small air space enclosed. While the likelihood of significant exposure is small, it is still theoretically possible. Improper wording would leave all areas where resin is handled under unnecessary surveillance diluting efforts at control of the real problem, burdening the industry with worthless expense and unnecessarily inconveniencing employees.

11. Section (L) (1, 2 & 3) Handling of waste material. Should the final regulation prevent discarding waste in landfills or by commercial disposal companies, the only option will be company owned incinerators at each plant with stack gas scrubbers. This would be an extremely expensive way to dispose of a little scrap. Should the final TWA and ceiling value be reasonable, the description of contaminated material will bear scrutiny.

12. Section (L) (4) Impervious suits. This section adds the requirement of impervious, air supplied, whole body suits to that of air supplied respirator, gloves and shoe coverings for vessel cleaning and maintenance on contaminated systems. This rule constitutes an extreme safety hazard. Reactor cleaners must climb through a manhole and down a ladder into the vessel. Then they must work on the curved bottom surface of the vessel, step over agitator blades and work from a ladder to clean the walls and dome. Just an air supplied mask trailing hoses is hazard enough without an air supplied suit. The activities of maintenance workers can be as demanding. They also must work from platforms and duck around equipment.

The perspiration generated in these suits would bring employees to the point of open rebellion. I doubt we could hire people to wear them.

Recruiting new personnel would be very difficult when it became known that employees wear space suits and air masks.

13. Section (L) (7) (ii) Provides for blanking off reactors when pipes are flanged but allows double block valves when pipes are welded. At Perryville we have flanged pipes but use double block valves with a bleed-off valve between. We feel this is less likely to cause exposure than blanking. Whenever lines are blanked, it is necessary to break open the flanges. These flanges are susceptible to leakage when reconnected. If double block valves are acceptable when pipes are welded, double block valves with a bleed-off between should be better since no pressure can build up between the block valves. Therefore, the likelihood of leakage into the reactor while cleaning is eliminated.

14. Section (m) Provides for purging of VCM unloading hoses with inert gas and handling of the inert gas in the recovery system or via a flare. It should be sufficient to purge the hoses with air to a safe location. This will be a very small quantity of VCM. It is not feasible to introduce inert gas like nitrogen into a recovery system or flare. Inerts increase VCM loss from recovery systems. Inerts in a flare system will require additional oxygen for efficient burning.

For safety reasons we have always tried to eliminate or restrict the use of inert gas. It is too easy to create atmospheres in confined spaces with insufficient oxygen. There have been deaths caused by accidentally using inert gas in place of air.

15. Section (c) Details the required reports to OSHA and to the employee for any exposure. It also restates the requirement for medical surveillance. As previously stated, even if the ceiling were to be finalized at 50 PPM, there would be numerous brief exposures. No differentiation is provided between minor exposures and gross exposures. The employer who provides the best monitoring system will have the most violations. The driving force is toward doing as little monitoring as possible. Certainly it discourages the installation of fixed continuous monitoring systems.

Fixed sequential monitoring systems with warning capabilities provide the best protection against extended exposures. Their installation should be encouraged by elimination of the need to report exposures which are promptly corrected.

MAY 30, 1974

1050

SAFETY ASPECTS OF THE WORK RULES INCLUDED
IN THE PROPOSED PERMANENT STANDARDS

The primary safety consideration overshadowing all others in PVC manufacturing plants has always been to avoid incidents allowing explosive concentrations of VCM in the plant atmosphere and to remove all possible sources of ignition. This is the first and most insistent instruction given to employees. This has got to continue to be true regardless of the concern for exposure to VCM. The safety of the plants after all possible engineering controls are installed rests primarily with capable, alert supervision, trained and conscientious operators and a capable maintenance crew. Some of the work rules in the proposed permanent standard militate against safe operation of the plants.

1. In announcing to our employees the temporary standard of 50ppm ceiling for VCM exposure, we promised to do all we could to reduce the amount of time air masks were required and to eliminate them entirely as soon as possible. This promise was made not only considering the discomfort and inconvenience of wearing a mask but also recognizing the concomitant safety hazards.

Operators and maintenance personnel wearing face masks and carrying an air bottle or trailing hoses cannot provide the alert surveillance needed to avoid accidents. Faulty maintenance is almost certain to occur at times because the craftsman cannot see clearly or is so preoccupied with the mask as to lose concentration on the job. Add to this a protective suit and the likelihood is increased. Add an air supplied impervious full body suit and the likelihood becomes a near

certainty. Survival of the plant and personnel becomes a matter of luck. Operators must read clearly the instruments describing the state of the reaction. They must be alert for upset conditions shown. They must concentrate on the job at hand. Put them in any of the aforementioned equipment and their alertness and concentration will diminish. Shoddy work and mistakes are certain to occur. One may have disastrous results.

Air masks must be accepted where absolutely necessary but space suits should not be used anywhere in a PVC plant.

2. The standard commands that employees abandon an area where any exposure to VCM occurs and return only after donning air masks. The work rules almost guarantee this by requiring that each exposure regardless of extent be followed by medical surveillance and detailed reports to OSHA and to the employees. While it may frequently be practical to leave the area and come back wearing masks, it is unwise to adopt it as an absolute practice. It may often be more prudent to accept a brief exposure to avoid a larger exposure or a mushrooming hazard. It would be impossible to guess how many lives have been saved by prompt action in sealing off ruptured lines, closing valves, transferring batches from leaking reactors. We have in the past frequently applauded heroic actions in such cases. After running out when the alarm sounds, who will go back in to see what has happened?

3. As previously stated, safety of the plant depends on trained personnel. The standard encourages the absence of these per-

3. sonnel from the job. A trip to the physician for each exposure regardless how brief, a shower if the employee claims to have had exposure to the liquid, a trip to the physician following the shower, lunch and breaks at a remote location--all of these remove trained employees from the poly building.

4. There is risk of injury to the employee due to falls, bumps, etc. while wearing air masks in the active type jobs of PVC manufacture. The risk is enormously increased when space suits are added.

IMPACT ON PLANT PRODUCTIVITY ON THE PROPOSED PERMANENT STANDARD AND THE LESS RESTRICTIVE ALTERNATIVES

An attempt was made throughout the impact estimates of people and equipment to provide sufficient amounts of both to maintain existing levels of plant productivity. Even so there will be situations, both normal and emergency in nature, that would slow the operation of the plant.

As the exposure limits become more restrictive, these situations will have a greater influence on what the plant can make. In the areas of 10 ceiling and 10 TWA, and in particular 0-1, there is no guarantee that the engineering changes proposed will provide the necessary production at all times.

At the 0-1 level it would be impossible to meet the standard at all times or even most of the time in the poly building. What would now be considered a minor upset or a normal maintenance operation taking only minutes or hours to rectify could take days or weeks. It is conceivable also that minor periods of exposure above ceiling limits would force total shifts to be out for medical surveillance and in fact shut the plant down temporarily.

With these considerations in mind, a very preliminary estimate is put forth below of the productivity penalties that would be incurred at the various levels of vinyl exposure.

PRODUCTIVITY PENALTY - ESTIMATE THE PERCENTAGE OF PRODUCTION LOST OVER PRESENT LEVELS

	50	40/25	15/10	0-1
Resin Productivity	3-5%	3-5%	5-10%	10-25%
Compound Productivity	3-5%	3-5%	3-5%	10-15%

In addition to the lost production while the plant is on stream there will be considerable down-time to install new equipment particularly at the lower levels of vinyl exposure. It is estimated that the plant will be down one to two years to retool at the 0-1 level.

ENERGY IMPACT FOR 50 PPM CEILING
EXISTING PERRYVILLE PVC PLANT

ITEM	GPM H_2O	#/HOUR STEAM	HP	CFM 100# AIR
A	0	0	5	5
B	1	500	1	0
C	0	0	0	0
D	10	0	225	5
E	0	0	0.25	2
F	5	1,500	30	4
G	2	0	10	1
H	0	0	0	0
I	10	0	150	0
J	0	0	5	0
K	0	0	1	0
L	0	0	1	1
M	0	0	0.25	0
N	0	0	2.0	2
O	0	0	50	0
P	0	0	2.0	4
Q	0	0	0	0
R	0	0	0	15
S	0	0	0	0
T	1	0	20	0
U	0	0	125	485
V	1	0	10	8
W	5	3,000	5	1
X	0	0	5	0
Y	10	200	10	5
	0	0		
	45 GPM	5,200 #/HOUR	627.5 HP	533 CFM
			125.0 HP	
			752.5 HP	

534,000 g/mo over min. bill'g. at 20¢/M

↓

$106.80/mo.
600.00/mo. sewer.
$706.80/mo.

↓

26.5% over existing

28,800 gal. F.O./mo. at 32¢/gal.

↓

$9,216.00/mo.

↓

14.4% over existing

at 0.80¢/kwhr & 1/3 demand

↓

$4,330.00/mo.

↓

11.7% over existing

ENERGY IMPACT FOR 40 /25 RANGE

ITEM	GPM H_2O	#/HOUR STEAM	HP	CFM 100# AIR
50 PPM Ceiling	45	5,200	627.5	533
B	0	50	6	2
C	4	1,500	135	5
D	0	0	5	0
E	0	0	150	0
	49 GPM	6,750 #/HOUR	923.5 HP	540 CFM
			125.0 HP	
			1,048.5 HP	

706M g/mo. over min. rate at 20¢/M.

37,440 gal/mo. at 32¢/gal.

$766.40/mo. Total

$11,981.00/mo.

$6,050.00/mo.

$141.40 H_2O/mo.

$625.00 sewer/mo.

28.75% over existing

18.7% over existing

16.4% over existing

ENERGY IMPACT FOR 15/10 RANGE

ITEM	GPM H_2O	#/HOUR STEAM	HP	CFM 100# AIR
40/25 Range	49	6,750	923.5	540
Less "J" on 50	0	0	-5.0	0
B	2	0	0.5	2
C	5	1,500	135.0	5
D	10	6,000	60.0	8
E	0	0	5.5	10
F	0	0	0	0
G	0	0	2	0
H	0	0	0	0
I	10	3,000	30	5
J	0	0	0.5	5
K	0	200	5.0	0
	76 GPM	17,450 #/HOUR	1,157.0 HP	575 CFM
			140.0 HP ←	
	↓	↓	1,297.0 HP	
	1.87MM g/mo. over min. rate at 20¢/M	95,040 gal. F.O./mo. at 32¢/gal.	↓	
	↓	↓	↓	
	$374.60			
	$1,020.00 sewer			
	$1,400.00/mo.	$30,415.00/mo.	$7,500/mo.	
	↓	↓	↓	
	5.25% over existing	47.5 % over existing	20% over existing	

ENERGY IMPACT FOR 0-1 RANGE

BEST GUESS

ITEM	GPM H_2O	#/HOUR STEAM	HP	CFM 100# AIR
15/10 Range	76	17,450	1,157.0	575
Less "I" on 50	-10	0	-225.0	-5
Less "M" on 50	0	0	-0.25	0
Less "O" on 50	0	0	-50.0	0
Less "V" on 50	-5	-3,000	-10.0	-8
Less "Y" on 50	0	0	-10.0	-5
Less "G" on 15/10	0	0	-2.0	0
Sub-Total	61	14,450	859.75	557
Plus:				
E	10	5,000	250	10
F	0	0	5	0
G	0	0	25	50
H	5	1,500	30	5
I	5	1,000	20	4
J	2	200	10	2
K	2	6,000	35	20
L	20	12,000	725	5
M	4	2,000	120	2
N	0	0	75	0
O	1	1,000	20	0
P	0	0	100	0
	110 GPM	43,150#/HOUR	2,272.75 HP	655 CFM
			162.0 HP	
			2,434.75 HP	

3.345MMgal/mo. over min. rate at 20¢/M

$ 678.00
1,600.00 sewer

$2,270.00/mo.

85.2 over existing

237,600 gal. F.O./mo. at 32¢/gal.

$76,000/mo.

119.0% over existing

$13,990.00/mo.

37.8% over existing

R. C. REIGHARD

RCR/sad
bb

IMPACT STATEMENT

OF

PROPOSED VCM EXPOSURE STANDARDS

FOR

PLANT II

SUMMARY OF TOTAL IMPACT OF THE PROPOSED OSHA STANDARD
OF VINYL CHLORIDE AND LESS HAZARDOUS ALTERNATIVES FOR PLANT #2

Equipment required in Plant II for compliance falls in the same general categories as that required in Plant I. The intent again is to contain all VCM possible and then exhaust away from personnel what cannot be contained.

PLANT II

	Less Than 50	40 PPM MAX 25 PPM TWA	15 PPM MAX 10 PPM TWA	NON-DETECTABLE	Prese
1. Capital Cost	$879,271	$2,122,447	$ 2,197,687	$5,615,827	
2. Operating Cost	$ 17,550	$ 28,715	$ 32,900	$ 62,510	
3. Operating Personnel	84	116	125	170	(
4. Percentage Decrease In Production	-5%	-8%	-10%	-20%	

Perrysville Plant 2 Revisions

50 PPM - Polymerization, Degassing, Drying

1.	Provide reactor ventilating system for removal of VC vapor during cleaning.	$ 66,400
2.	Provide reactor building vacuum exhaust system.	112,400
3.	Provide injection heater for purge water.	4,600
4.	Provide portable blower, explosion-proof, with hoses.	5,000
5.	Provide piping additions to pipe water containing VCM outside.	19,600
6.	Provide alarms on polymerization building fans.	30,000
7.	Provide improved ventilation on blend tanks.	3,000
8.	Provide improved ventialation in dryer building.	17,200
9.	Provide ventilation for dryer feed system.	79,400
10.	Provide emergency power generation for ventilators.	35,000
11.	Painting (all items above)	20,000
	Sub-Total	$ 392,600

50 PPM - Continuous Waste Treatment System Rather Than Batch and Monitoring

Modify waste treatment system extensively - equalization, clarification, control, etc.	$ 146,515
Provide a fixed sequential monitoring system including 3-12 point detector units, 1-40 point recorder/calculator and 1-40 point alarm panel	127,000
Total for 50 PPM	$ 666,115

Total 50 PPM	$ 666,115
Plus 10% Engineering	66,611
	$ 732,726
Plus 20% Contingency	146,545
Grand Total	$ 879,271

Believe this estimate is low. F. F. Hoy

25 PPM TWA - 40 PPM Ceiling

1.	Provide all modifications listed under 50 PPM.		$ 666,115
2.	Extend intake to polymerization building control room air conditioning unit to a height at least 20 feet above all exhause stacks.		800
3.	Provide ventilation system for emulsion filters.		8,700
4.	Provide reactor cleaning system: a) Option 1 - High pressure water system $159,600 b) Option 2 - Solvent cleaning system 400,000		400,000
5.	Extend vent lines from seal vessels to roof level		2,000
6.	Provide pull type ventilation system for blend tanks.		6,000
7.	Connect sludge tank vent lines to blend tank ventilation system.		6,000
8.	Provide additional ventilation for plate-type heat exchanger.		9,800
9.	Provide increased ventilation at blend tank shed plus additional unit heater (s).		2,000
10.	Silos: a) Provide continuous aeration of silos with 30 psig air (40,000) b) Add 3 additional silos, complete, to provide greater residence time (350,000)		390,000
11.	Provide ventilation system to exhaust VCM vapor from lift station.		12,000
12.	Extend all relief lines 20 feet above polymerization building low roof.		4,500
13.	Provide 1 additional blend tank, complete, to isolate latex resulting from an upset in the polymerization.		100,000
	Total for 25 PPM TWA, 40 PPM Ceiling		$1,607,915

Total 25 PPM TWA, 40 PPM Ceiling	$1,607,915	
plus 10% Engineering	160,791	
	1,768,706	
plus 20% Contingency	373,741	
Grand Total	$2,122,447	

10 ppm TWA, 15 ppm Ceiling

1.	Provide all modifications listed under 50 ppm and 25 ppm TWA, 40 ppm ceiling.	$1,607,915
2.	Provide a permanent ventilation system at the seals of P-4200 A&B and P-4215.	4,200
3.	Increase ventilation in polymerization building from 10/20 to 20/40 air change per hour.	23,800
4.	Increase capacity for steam sparging of reactors.	5,000
5.	Double dryer feed ventilation	3,000
6.	Provide a reactor sampling device such that no VCM is liberated during sampling.	1,000
7.	Provide fresh air ventilation of warehouse.	20,000
	Total for 10 ppm TWA, 15 ppm Ceiling	$1,664,915

Total for 10 ppm TWA, 15 PPM ceiling	$1,664,915
plus 10% Engineering	166,491
	1,831,406
plus 20% Contingency	366,281
Grand Total	$2,197,687

0-1 PPM

1.	Provide all revisions listed under 50 PPM, 25 PPM TWA, 40 PPM ceiling, and 10 PPM TWA, 15 PPM ceiling.		$ 1,604,915
2.	Provide new, 100% leakproof flange design for VCM containing lines.		10,000
3.	Provide all-welded VCM lines.		6,000
4.	Provide new 100% leakproof seals for P-4200 A&B and P-4215.		5,000
5.	Provide additional stripping capacity - building, vessels, seal vessels, vacuum system, condensers and controls		570,000
6.	Combine all VC ventilation exhaust lines, including all dust collector exhausts to a common flare system.		1,800,000
7.	Provide 10,000 gallon pressure/vacuum vessel for polymerization emergencies:		
	a) 1-10,000 gallon vessel complete with agitator and seal system	$40,000	
	b) 1-complete Nash vacuum system plus complete Nash compresser system	60,000	
	c) 1 VC condenser	15,000	
	d) 1 VC vent condenser to exhaust to flare system	6,000	
	e) 1 pump out system	2,500	
	f) Mechanical installation	14,000	
	g) Electrical installation	18,000	
	h) Piping	6,000	
	Total Package	$161,500	161,500
8.	Provide cover and ventilation system for 100,000 gallon equalization tank.		37,000
9.	Provide incineration system for dewatered sludge and scrap ($2,500,000 included in Plant 1 revisions)		
	Total 0-1 PPM		$ 4,254,415

Total 0-1 PPM	$4,254,415
Plus 10% Engineering	425,411
	4,679,826
Plus 20% Contingency	935,971
Grand Total	$5,615,827

Manpower Impact

VCM Constraint	Operating	Maintenance	Office	Monitoring	Total Staffi
None (Current)	43	11	9	0	63
50 ppm	51	19	10	4	84
25 ppm TWA/40 ppm Ceiling	63	35	12	6	116
10 ppm TWA/15 ppm Ceiling	67	39	13	6	125
.0-1 ppm	83	63	16	8	170

OPERATING COST IMPACT

VCM Constraint	Increment Cost Per Month	Cumulative Cost Per Month
50 ppm	$17,550	$17,550
25 ppm TWA/40 ppm ceiling	11,165	28,715
10 ppm TWA/15 ppm Ceiling	4,185	32,900
0-1 ppm	29,610	62,510

50 ppm - Polymerization, Degassing, Drying

Change #	Fuel Oil (gal/hr)	Electric (HP)	Water (GPM)	Steam (#/hr)	Air (CFM)
1	-	50	-	-	-
2	-	200	.5	-	2
3	-	20	-	-	-
4	-	-	-	-	-
5	-	1	-	-	-
6	-	30	-	-	-
7	-	60	-	1,000	-
8	-	15	-	-	-
9	-	-	-	110	-
10	50	-	-	-	-
11	-	-	-	-	-
Sub-total	50	376	.5	1,110	2

50 ppm - Waste Treatment

1	-	50	-	-	-
2	-	10	-	-	-
3	-	-	-	-	-
4	-	40	-	-	-
5	-	60	10	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	10
10	-	-	-	-	-
11	-	-	-	-	-
Sub-total	-	160	10	-	10
Total for 50 ppm	50	536	10.5	1,110	12
Operating Cost/Month	$11,520	$4,060	-	$1,970	-

Total Incremental Operating Cost Increase at 50 ppm = $17,550/month

25 ppm TWA/40 ppm Ceiling

Change #	Fuel Oil (gal/hr)	Electric (HP)	Water (GPM)	Steam (#/hr)	Air (CFM)
1	-	-	-	-	-
2	-	-	5	1,000	-
3A	-	160	10	-	-
3B	-	250	10	3,000	5
4	-	-	-	-	-
5	-	25	-	-	-
6	-	-	-	-	-
7	-	10	-	-	-
8	-	10	-	50	-
9	-	-	-	-	650
10	-	50	-	-	-
11	-	-	-	-	-
12	-	20	.1	100	10
Sub Total/ Total	-	365	25.1	4,150	665
Operating Cost/month	-	$2,760	-	$7,355	$1,050

Total Incremental Operating Cost Increase at 25 ppm TWA, 40 ppm ceiling = $11,165 per month + $17,550 = $28,715 per month

10 ppm TWA/15 Ceiling

1	-	10	-	-	-
2	-	60	-	1,500	-
3	-	-	-	220	-
4	-	30	-	-	-
5	-	-	-	-	-
6	-	50	-	-	-
Total	-	150	-	1,720	-
Operating Cost/Month	-	$1,135	-	$3,050	-

Total Incremental Operating Cost Increase at 10 ppm TWA/ 15 ppm Ceiling = $4,185 per month + $28,715 = $32,900 per month

0-1 ppm

Change #	Fuel Oil (gal/hr)	Electric (HP)	Water (GPM)	Steam (#/hr)	Air (CFM)
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5 - Option #1					
1	-	-	-	-	-
2	-	15	22RW	-	6
3	-	20	-	-	-
4	-	(210	.6	-	10
5	-	(	-	-	-
6	-	-	19RW	-	-
7	-	-	-	-	-
5 - Option #2					
1	-	-	-	-	-
2	-	15	22RW	-	6
3	-	4	-	-	-
4	-	20	-	50	-
5	-	(210	.6	-	10
6	-	(	-	-	-
7	-	-	19RW	-	-
8	-	-	-	-	-
6	100	100	-	-	20
7 1	-	25	-	100	5
2	-	(150	.4	-	5
3	-	(	-	-	-
4	-	-	10RW	-	-
5	-	-	-	-	-
6	-	10	-	-	-
8	-	30	-	1,000	-
Total	100	564	51RW	1,150	46
Operating Cost/month	$23,000	$4,270	$200	$2,040	$100

Total Incremental Operating Cost Increase at 0-1 ppm = $29,610 per month + $32,900

= $62,500 per month

CATALYTIC, INC.

COPY

31 May 1974
CI Letter No. 103

Mr. Robert J. Kerrigan
Project Manager
Firestone Plastics Company
P.O. Box 98
Perryville, Maryland 29103

SUBJECT: Firestone Plastics Company
Perryville, Maryland
ORDER OF MAGNITUDE CAPITAL COST
ESTIMATES-ALTERNATE VINYL CHLORIDE
(VCM) CONCENTRATION LEVELS

Dear Mr. Kerrigan:

We have prepared "order magnitude" capital cost estimates for modifications to Firestone PVC plants at Pottstown, Pa. and Perryville, Maryland to maintain VCM concentrations at four alternate operating levels, namely;

Case I	0—1 ppm
Case II	10 ppm avg.; 15 ppm max
Case III	25 ppm avg.; 38 ppm max
Case IV	50 ppm ceiling limit

The capital costs for each plant and for each Case are presented in the attached estimating summary sheets. The estimates are based upon the scope of work for each plant and each Case as submitted by Firestone and dated 26 May 1974.

If you have any questions or comments, please do not hesitate to contact us.

Yours truly,

C.O. Livingston

C.O. Livingston
Project Manager

COL:ll
Attachments

cc: R. Pavlin
J. O'Connor
K. Hochschwender
R. Klopp
F. Knoll
W. O'Connor
J. Farrell
J. Lastowka
File

CONFIDENTIAL

CATALYTIC INC

Summary Sheet

Date 5/30/74

Case I — No Catalyst Level

Case II — 100 ppm TWA 15 Cig

Case III 25 ppm TWA 35 ppm Ceiling

Case IV 50 ppm Limit

132

1330

CONFIDENTIAL

CATALYTIC INC

Date JULY 30 1974

CASE II

CASE III

CASE IV

133

1031

CONFIDENTIAL

CATALYTIC INC

Summary Sheet

Case II

Case III
15/10 min

Case III
37.5/25 min

Case III
[illegible]

137

THE ECONOMIC IMPACT OF THE PROPOSED PERMANENT VCM STANDARD ON FIRESTONE AND THE DOMESTIC PVC INDUSTRY

The economic impact can be summarized into five major factors:

1. Capital investment to modify the plant to meet the standards.

2. Manpower to operate a plant considering reduced employee efficiency resulting from the work practices, and increased supervision and staff personnel to insure compliance with the standards.

3. Plant capacity cannot be maintained at present levels, even with significant input of capital.

4. Labor rates will probably increase significantly as the PVC industry is tagged with "hazardous industry" label. To insure availability of quality production and maintenance personnel, labor rates will probably have to increase 25% over current levels.

5. Support costs to provide personnel with required clothing, respiratory equipment, medical tests and personal hygiene.

The following grid offers a concise picture of the impact of these variables and the total effect on Firestone's operation and potential price increases which will be passed on to the consumer as a result of this action:

	VCM LEVEL - PPM				
	Current	50	25/40	10/15	0
Capital Investment	100	133	160	212	304
Worker Efficiency Index	100	57	53	41	32
Profit Index	100	64	55	30	3
Price Index	100	115	120	133	155

The economic data offered throughout this paper is based solely on changes within the PVC manufacturing processes used at Firestone. It does not consider any changes in the packaging or cost of incoming raw materials or outbound finished product. Raw material cost increases, especially for vinyl chloride monomer, are imminent. The amount of increase will depend on the VCM standard that is finally adopted. The processing changes are so complex that we feel it is better left to VCM manufacturers to predict the consequences of the standards on their segment of the industry.

Specific comment on the index data offered above is:

Capital Investment Index

The following chart summarizes the original cost of our plants and projected total revised costs at the various

VCM levels. It also shows the annual capacity level at the various alternatives and the capital investment per million pounds of annual capacity.

	VCM LEVEL - PPM				
	Current	50	25/40	10/15	0
Capital Investment (000 omitted)					
Pottstown	22,987	29,987	37,787	52,137	52,987
Perryville A	14,697	16,842	17,650	22,372	33,731
Perryville B	11,998	12,491	14,448	14,566	18,573
Total	49,682	59,320	69,885	89,075	105,291
Capacity (MM pounds)					
Pottstown	190	155	145	125	90
Perryville A	259	249	249	242	217
Perryville B	58	55	53	52	46
Total	507	459	447	420	353
Capacity Investment Per MM Pounds of Annual Capacity (000 omitted)					
Pottstown	120.9	193.5	260.6	417.1	588.7
Perryville A	56.7	67.6	70.9	92.3	115.4
Perryville B	206.9	236.2	272.6	280.1	403.8
Total	384.5	497.3	604.1	789.5	1107.9

Capital Investment Index	Current	50	25/40	10/15	0
Pottstown	100	160	216	345	487
Perryville A	100	119	125	163	274
Perryville B	100	114	132	135	195
Total	100	133	160	212	304

Details of the general equipment modifications necessary to meet the VCM levels for each alternative are set forth in the production/engineering reports. At the proposed permanent standard, the best we can realize is a 32% drop from the present plant capacity. Demand for PVC during the last year and a half has been so strong that we have operated our plant at full capacity. The situation was essentially the same for the entire industry. If our capacity losses are indicative of the total industry, it could lose about 1.5 billion pounds of its capacity. This would aggravate the already serious material shortage which has plagued the U.S. economy.

A penalty which has been excluded from the statistics presented in this paper is the down time necessary to retool the plants to comply with the proposed permanent standards. Much additional engineering data is needed before

the physical retooling process is begun; however, our estimate is that the plants would be totally shut down for at least one and perhaps more than two full years. Again, if this estimate is indicative of the general industry, even if plants were modified on an industry-enforced time schedule, serious disruption of material supplies is almost an unavoidable consequence.

The age of the plant and the plant's production methods and product mix play important parts in determining the capital investment to meet standards. For example, Firestone has two plants of reasonably similar volumes. One plant is about six years old and is strictly a suspension polymerization/rotary drying operation. The other plant is over twenty-five years old; it has been regularly modernized and well-maintained, and it uses both suspension and emulsion polymerization techniques and rotary and spray drying techniques. The capital investment of comply with the standards for the older plant are significantly more than the capital investment for the newer plant. The following chart shows the relative investments.

	VCM LEVEL - PPM				
Capital Investment Index	Current	50	25/40	10/15	1
25 Year old plant	100	160	216	345	487
8 Year old plant	100	119	125	163	274

A logical assumption if data presented in above chart is indicative of industry is that manufacturers with older plants will face a significant competitive disadvantage, and elect to cease production of PVC resins. This would have a significant adverse effect on the availability of PVC materials and the general domestic economic climate.

There are twenty domestic manufacturers with total capacity of 4.9 billion pounds (May 1974 - Modern Plastics). By 1975, there should be twenty-three manufacturers capable of producing 6.3 billion pounds (May 1974 - Modern Plastics). These manufacturers will be operating about 37 polymer plants. A tabulation of the plants according to capacity is as follows:

Annual Capacity (Millions of Pounds)	No. of Plants
Under 100	6
100 - 150	5
150 - 200	7
200 - 250	18
250 - 300	-
300 plus	1
	37

The age, condition and production methods of these plants vary considerably. However, if the data applicable to Firestone is indicative of the industry average, capital outlays of $50 - 230 million are conceivable to meet the temporary ambient air and work practices standards, with price tag most likely around $140 million.

Estimates of capital outlays for the industry to meet the proposed permanent standards - if in fact compliance is possible - range between $450 million and one billion dollars with $750 million being most likely point within that range.

Worker efficiency index

The proposed work practices, including use of impervious clothing, mandatory personal hygiene practices, medical testing and surveillance, and personnel monitoring will significantly reduce the productivity of the individual worker. Large segments of the work force will spend most of their time in "space suits", and be extremely uncomfortable and more subject to fatigue. Additional rest periods will be necessary. The work force will more than double.

Below is a tabulation of the total plant manning for the various alternatives. The production/engineering summaries delineate the necessary increase by job classification as well as work practice rule.

	VCM LEVEL - PPM				
	Current	50	25/40	10/15	0
Total Manpower	435	684	710	872	927
Increase		249	275	437	492
% Increase	Base	57%	63%	100%	113%

Profit Index

Under present market conditions, where all PVC products are in short supply and command premium prices, Firestone is realizing a reasonable profit level. The impact of the proposed permanent standard, assuming no price relief, would be to essentially wipe out all existing profits.

We estimate the present condition will remain essentially the same for the next two to three years. However, the long-term history of the PVC industry is prices are not as stable as currently exist. If market demand were to soften, the profit drain resulting from less-than-full capacity operations and lower selling prices could force us and the industry into a loss position. This is the risk inherent in any private business venture. The point is that unrealistic governmental interference that substantially increases the cost of doing business and limits profit opportunities increases this risk geometrically. If the risk becomes too great, private investors will divert their funds to competitive sources offering a more viable potential for a

satisfactory return on their investment. The consequence could be the death of the PVC industry.

The age, size, production methods and products produced vary from plant to plant. All these factors will influence the individual plant's profit potential. The chances for sizable deficit operations are much higher with the older more complex plant. It's predictable that some of these will not take the risk.

Price Index

It is estimated that prices would have to increase over 50% just to offset the additional costs from the proposed permanent standard. Since capital investment per pound of product is over 200% higher than current levels, the profit rate per pound of product must also increase to maintain a reasonable return on investment. Furthermore, the higher capital risk outlined in the profit index comment must be offset by still higher prices in order to attract the necessary funds. With the combination of these three factors, a doubling of the current price is a plausible possibility. The potential offset of increased prices by the 4.8 billion pound industry could easily exceed $1.0 billion annually.

June 15, 1974

THE MERCURY

PAGE 4 MONDAY, APRIL 12, 1971

'Save The First Amendment'

Firestone Honesty

Firestone Tire and Rubber Co. set an example last week that all industries — and government officials — would do well to follow.

The Lower Pottsgrove plant is one of many in the country to use vinyl chloride in its manufacturing process.

In recent weeks, evidence has indicated the substance causes a rare form of liver cancer that usually is fatal.

An investigation was made into the death of an area man in 1969. He worked at Firestone, exposed to vinyl chloride, for 20 years. And this month investigators concluded his death was related to the chemical at the plant.

In the face of such findings many companies would have attempted to cover up the investigation.

Not Firestone.

As soon as the results were known, officials made them public. They didn't dispute the findings or try to duck responsibility.

They stated the situation plainly, vowed to continue investigating the effects of vinyl chloride and announced a new medical program to safeguard employes.

This attitude of recognizing a problem, dealing with it frankly and in the open is rare these days.

Too often, in government as well as industries, the primary concern in the face of a problem is how to keep the public from finding out about it.

But Firestone's action shows that openness ultimately draws respect and trust.

No matter how serious or tragic a situation is, the people can accept it if they know they are being told all the facts and that an honest effort is being made to correct the problem.

Since Firestone's initial statement, national action has been taken to remove substances containing vinyl chloride from the market.

If the company had not been honest about its use of the chemical, accusations might have begun by now pointing to Firestone as a villain.

Speculation based on incomplete information would have been more damaging to the company than the truth is. But such speculation always results when the public is not told the facts.

Having been told of the situation, people feel satisfied that their trust has not been violated.

Instead of drawing criticism for past mistakes, honesty such as that displayed by Firestone only inspires respect and trust from the public.

It's something for other officials — in industry and government — to think about.

UNIVERSITY OF CALIFORNIA, SAN FRANCISCO

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO SANTA [illegible] • SANTA CRUZ

SCHOOL OF MEDICINE
DEPARTMENT OF MEDICINE
DIVISION OF AMBULATORY AND COMMUNITY MEDICINE

SAN FRANCISCO, CALIFORNIA 94143

13 June 1974

My name is Dr. Thomas H. Milby. I am Adjunct Associate Professor of Occupational Medicine and Environmental Health at the School of Public Health, University of California, Berkeley, and the School of Medicine, University of California, San Francisco. I Have been asked by the Firestone Plastics Company, as a consultant, to address you on their behalf.

It is not my intention to summarize the studies relevant to this issue, since these data will be presented in detail by others. Nor will I suggest a definitive TLV level for vinyl chloride, though I urge that some number be considered for a standard.

We are facing an issue which has perplexed experts in the field of occupational health for many years. Namely, how does one reconcile the condoning of exposure of workers, or any other segment of the population, to any substance which may produce severe injury or death? In this regard, a compound which may induce cancer is no different than one which may cause serious damage to the lung, liver, or any other vital organ. The answer, of course, is that it is impossible to go about our task of daily living without assuming some degree of risk. One can not eliminate all risk from any of life's operations; it then simply becomes a matter of what is the probability that we would be able to protect the great majority of workers by prescribing certain acceptable concentrations. I can not conceive of the concept of a zero level of exposure for any substance. Certainly you are all familiar with OSHA's list of 14 carcinogenic compounds; all of us know that there are others, as well.

We have before us the following facts: Vinyl chloride is capable of producing a very virulent cancer in some species, and most likely man is one of these species. While the cancer is virulent once conceived, vinyl chloride is a weak carcinogen insofar as both human and animal data indicate, despite the fact that some of these data are less convincing than we would like to have.

In some species we cannot produce the tumor at all, at least insofar as present data suggest. In the mouse, data suggest that at 50 parts per million the compound induces angiosarcoma in but 1 or 2% of the

test animals. If we were dealing with a potent carcinogen, for example methyl cholanthrene, 70, 80 - perhaps even 100% - of the exposed animals would develop the tumor of interest.

In man the attack rate of this disease is unknown. I believe it is safe to say that the background level of angiosarcoma in the population in this nation is miniscule. It is a unique and rare tumor. In the Life Table Study, recently reported by the Manufacturing Chemist Association, among some 8,400 vinyl chloride workers who had at least one year of occupational exposure prior to December 31, 1972, 6 angiosarcoma deaths were reported. The minimum number of years at the time of death was approximately 15.

While this suggests that there is reason for grave concern, we must conclude that it is possible to work with this product with relative safety. There are many questions to be answered. The question of clustering, the possibility of a contaminant, better definition of the dose-response curve in animals, the probable no-effect level in man. Answers to many of these technical questions will ultimately emerge.

The point is that we are faced with a grave problem, which I believe, must be kept in perspective. Namely, we have a weak carcinogen and we have a clear excess of a rare tumor among those occupationally exposed to VC. At this juncture, all we know is that the unfortunate victims of angiosarcoma who had worked in the vinyl chloride industry had been exposed to an immense amount of vinyl chloride over the years because, historically, it has been considered only as a hypnotic, probably of no more health importance than gasoline or acetone.

My conclusions are that: There is a precedent for working with carcinogens at greater than "non-detectable" levels. A TLV of "non-detectable" concentration is a break with that precedent. Whatever number which will be set at this time will be set without the advantage of all the data which we would like to possess. The concept of socially acceptable risk will need to be applied. I think that those who make the final decision should keep that in mind.

We wish you well in your deliberations.

Thomas H. Milby, M.D.

Office of the Dean
School of Medicine
HEALTH SCIENCES CENTER
State University of New York at Stony Brook
Stony Brook, New York 11790
516 444-2080

1095

June 5, 1974

Dr. Robert S. Brookman,
Manager, Research & Development
Firestone Plastics Company
Pottstown, Pennsylvania 19464

Dear Dr. Brookman:

I am enclosing a report of my evaluation of the experimental exposures of animals to vinyl chloride. As I indicated to you in our telephone conversation, I do not have the latest Maltoni results and would be most anxious to see them. I trust you will find this of some use to you.

I am returning to you, under separate cover, that portion of the material which you requested.

If I can be of any further help, please do not hesitate to call on me.

Sincerely,

Marvin Kuschner, M. D.
Dean, School of Medicine
Chairman, Dept. of Pathology

MK/eb
Encl.

RECEIVED
JUN 10 1974
R. S. BROOKMAN

ALLIED HEALTH PROFESSIONS • BASIC HEALTH SCIENCES • DENTAL MEDICINE • MEDICINE • NURSING • SOCIAL WELFARE

REVIEW OF EXPERIMENTAL CARCINOGENESIS WITH VINYL CHLORIDE

June 5, 1974

Much of the early experience with animal exposure to vinyl chloride relates to acute toxicity in short term experiments.

In 1961, Torkelson, Oyen, & Rowe reporting on the effects of up to 6 months of repeated exposure at levels of 500, 200, 100, or 50 ppm did not record any tumorigenic effects. Rats, rabbits, guinea pigs, and dogs were used. Some insight into the absence of tumor induction in this experiment may be obtained from the details of the rat experiment. Groups of 10 male and 10 female rats were exposed to 500 ppm for seven hours, five days a week, for 4.5 months. 7 out of 10 males and 9 out of 10 females survived the period of exposure and were sacrificed on its completion. Groups of 12 males and 12 females were similarly exposed for 7 hours daily (additional groups were exposed for shorter periods) to 200 ppm and 1 ppm. Survivors again were sacrificed at the end of the 6 month period. Smaller groups of 6 to 8 animals exposed to these lower levels were pastured for 6 to 8 weeks on the completion of exposure and then sacrificed. Thus none of the animals exposed to 500 ppm were permitted to survive beyond 6 months and the maximum period of exposure and observation in the lower level exposure groups was 8 months. In the light of the later observation of Maltoni that at 56 weeks only 1 angiosarcoma had been observed in a group of 60 animals exposed for <u>one year</u> to 2500 ppm and 1 angiosarcoma in a group of 60 animals exposed for one year to 500 ppm, the early Torkelson paper must be dismissed as an inadequate model for tumor induction - both in duration of exposure and in the period of observation.

In 1970, Viola described the effects of exposure of Wistar rats to vinyl chloride at levels of 30,000 ppm for 4 hours a day, 5 days a week, for twelve months. This paper was published in Medicina del Lavoro. The number of survivors is not made clear in this paper. However, in a later paper to be described below involving the same piece of work, we learn that only 6 were permitted to survive for 380 days and most died before one year. Severe toxicity was observed with the production of lesions comparable to acro-osteolysis in man, neuronal degeneration in the brain with reactive gliosis and a poorly defined renal tubular lesion. No tumors were described in this paper but it is of particular interest that in the liver, in addition to evidence of hepatic cell damage, the author makes the following statement, "there was evidence of an abnormal proliferation of the Kupffer cells which were often hypertrophic." This sounds very much like a possible forerunner of neoplastic transformation of these cells which are the cells of origin of angiosarcoma. Indeed, such changes would seem to resemble those early changes described by Popper and Thomas at the New York Academy of Sciences meeting in May of 1974. This exposure level was extraordinarily high, however, and does not particularly illuminate for us the effect of chronic low level exposure. In a subsequent paper describing oncogenic effects in the same experiment published in Cancer Research in 1971, Viola describes 17 of the 25 animals as having skin tumors and 6 of these as also having lung tumors. Maltoni later reviewed these and interpreted them as primary tumors of Zumbal's gland with the 6 lung tumors representing metastatic deposits. The 4 osteochondromas Viola describes may be interpreted as not necessarily true tumors but more likely as hyperplastic

response to injury in the animal equivalent of acro-osteolysis. This experiment, then, does not assist in the evaluation of angiosarcoma production but does demonstrate for the first time that vinyl chloride is an effective carcinogen, if one can accept the claim that no significant contaminants were present in the exposure medium.

Following this report Maltoni embarked on a series of studies designed to examine dose response relationships, strain differences (Sprague-Dawley as contrasted with Wistar rats), species differences (rats, mice, and hamsters) dose-rate effects, effects on offspring of exposed pregnant rats, and route of administration (inhalation, ingestion, intraperitoneal injection and subcutaneous injection). The protocols for these experiments are charted in Maltoni's outline attached to this report as Maltoni Appendix A. These experiments appear well designed and carefully executed. Concerns expressed in regard to detail such as the presence of food, and bedding in the cage during exposure and the possibility of low concentration or trace contamination in the gas as administered are proper but would appear to be answered by the confirmation to be discussed below in the Bio-Test experiments. The latest printed report of Maltoni's results available to me is as of February 10, 1974 and the duration of the various experiments as of that date is given in Maltoni Appendix A. It may be seen that the only experiment that had matured by that date is experiment BT 1. The tumor yield in that experiment is given in Maltoni Appendix B. My own long experience with this strain of rat would lend credence to the fact that Zymbal gland carcinomas, nephroblastomas, and liver angiosarcomas are in all likelihood related to exposure. Of

particular interest, in the light of human experience is the presence of a strong suggestion of dose related occurrence of angiosarcoma of the liver at levels of 250 ppm to 6,000 ppm with perhaps some fall off at 10,000 ppm due to interfering affects. The other experiements had not been in progress long enough. Reference has already been made above to the fact that even at 56 weeks which is where experiment BT 3 was on February 10, 1974, no angiosarcomas could have been expected and Maltoni's report to OSHA on March 16th does not record any. No tumors had been observed in mice at 31 weeks which is of interest in the light of the Bio-Test report to be discussed below.

At the New York Academy of Sciences meeting on May 10th and 11th, 1974, Maltoni updated his results but I am not certain of these except for the statement that he had begun to see tumors at 50 ppm. It would be most important to get these data.

On September 10th, a series of exposures were initiated by Bio-Test Laboratories. These were designed to expose groups of 100 males and 100 females of 3 rodent species (mice, rats, and hamsters) to levels of vinyl chloride of 50, 200, and 2500 ppm for 7 hours a day, 5 days a week, for one year. By April 9th, 7 months after the start of exposure, 2 of 4 mice exposed to 50 ppm had been examined and found to have angiosarcomas of the liver, as had 4 of 6 mice in the 200 ppm, and 17 of 19 mice in the 2500 ppm group. At the May, 1974 New York Academy of Sciences meeting, 8 months after the start of exposure, these incidences were updated to 2 of 4 at 50 ppm, 11 of 15 at 200 ppm, and 28 of 30 at 2500 ppm. It is of interest that the earliest tumor was seen 5 1/2 months after the start of exposure. Maltoni's results in his

February report was of no tumors at 31 weeks in the same strain of mouse. However, Maltoni's exposure was for four hours daily, whereas Bio-Test was a seven hour a day exposure.

It would appear that the Swiss albino mouse is a highly sensitive indicator of angiosarcoma-inducing potential. Should no additional tumors be seen in the 50 ppm group, two are sufficiently sticking in this relatively small group, however, the denominator is calculated. This is made more impressive by incidences of 66% and 93% in the 200 ppm and 2500 ppm groups respectively.

Comment: There is little reassuring in the animal data so far available in regard to acceptable levels in humans. The enormous difficulty in inter-species extrapolation is emphasized by the difference between Maltoni's 9 out of 74 rats (12%) with angiosarcoma of the liver after exposure to 2500 ppm and Bio-Test's 28 out of 30 mice (93%) at the same level. Nevertheless, the question may properly be asked as to the possibility that man is considerably less susceptible than either of these rodent species. That man is to some degree susceptible seems clearly demonstrated by the cases associated with occupational exposure, but it seems likely that these exposures were at levels considerably higher than those now attainable in the work-place. I would predict that further experimental exploration of lower levels in larger numbers of the rodent species will produce no reassuring results. Rather, determined efforts to define and identify low-level occupational exposures in which no tumors have occurred would seem potentially more productive. Studies of the mechanism of induction of this very rare tumor with its curious target tissue may offer insights into potential ways of interfering with process of

malignant transformation.

On the basis of the scientific and medical evidence now available, there is not sufficient knowledge for determining a safe level of VCM exposure for humans. Neither is there sufficient medical or scientific knowledge to conclude that levels at which no detectable ill effects occur do not exist.

Respectfully submitted,

Marvin Kuschner, M. D.

NO. OF THE EXPERIMENTS	TREATMENT			ANIMALS							
	Route	Doses or VC	Length	Species	Strain	Age (weeks)	No. ♀	No. ♂	No. Total	Weight grams	
BT1	Inhalation	10,000, 6,000, 2,500, 500, 250, 50 ppm. Untreated controls Treated controls: Va 2,150 ppm.	4 hrs. daily, 5 days weekly, 52 weeks	Rat	Sprague-Dawley	13	268	309	577	64-96	127
BT2	Inhalation	200, 150, 100 ppm. Untreated controls	4 hrs. daily, 5 days weekly, 52 weeks	Rat	Sprague-Dawley	13	280	265	545	65-120	31
BT3	Inhalation	10,000, 6,000, 2,500, 500, 250, 50 ppm. Untreated controls	4 hrs. daily, 5 days weekly, 17 weeks	Rat	Sprague-Dawley	21	262	288	550	60-190	56
BT4	Inhalation	10,000, 6,000, 2,500, 500, 250, 50 ppm. Untreated controls	4 hrs. daily, 5 days weekly, 30 weeks	Mouse	Swiss	11	250	260	510	60-150	31
BT5	Transplacental	10,000, 6,000 ppm.	4 hrs. daily, 7 days (from 12th to 18th day of preg	Rat	Sprague-Dawley	19 Breeder 12 days Embryos	110	36	146	30-54	65
BT6	Inhalation	30,000 ppm.	4 hrs. daily, 5 days weekly, 11 weeks	Rat	Sprague-Dawley	17	30	30	60	60	31
BT7	Inhalation	10,000, 6,000, 2,500, 500, 250, 50 ppm. Untreated controls	4 hrs. daily, 5 days weekly, 52 weeks	Rat	Wistar	11	-	220	220	30-40	31
BT8	Inhalation	10,000, 6,000, 2,500, 500, 250, 50 ppm. Untreated controls	4 hrs. daily, 5 days weekly, 30 weeks	Hamster	Golden	11	-	268	268	32-70	18
BT9	Inhalation	50 ppm. Untreated controls	4 hrs. daily, 5 days weekly, 52 weeks	Rat	Sprague-Dawley	11	200	200	400	100 (c) 300 (t)	3
BT10	Inhalation	10,000. 6,000 ppm. Untreated controls	4 hrs. daily, 5 days weekly, 5 weeks; 4 hrs. daily, 1 day weekly, 25 weeks; 1 hr. daily, 4 days weekly, 25 weeks	Rat	Sprague-Dawley	11	420	420	840	120	3
BT11	Ingestion	16,6 mg.; 3,32 mg.; 50 mg/kg body weight, in olive oil Controls: olive oil	5 times weekly, 52 weeks	Rat	Sprague-Dawley	13	160	160	320	80	3
BT12	Subcutaneous injection	4,25 mg. in 1,0 cc. olive oil Controls: 1,0 cc. olive oil	4, 3, 2 times by two months, and once	Rat	Sprague-Dawley	13	150	150	300	60	
BT13	Subcutaneous injection	4,25 mg. in 1,0 cc olive oil Controls: 1,0 cc olive oil	1 injection	Rat	Sprague-Dawley	21	80	70	150	75	

EXPERIMENT BT11 RESULTS AFTER 127 WEEKS

GROUP AND TREATMENT	ANIMALS (DIPACUF-DAILY RATE)		ANIMALS WITH TUMOURS					
			Zymbal gland carcinoma (a)	Neuroblastoma (b)	Angiosarcoma		Other type and/or site	Total
	Total	Survivors			Liver (c)	Other sites		
	No.		No.	No.	No.	No.	No.	No.
I VA 2,500 ppm.	96	-	-	-	-	-	-	-
II VC 10,000 ppm.	69	-	13	3	6	-	5 (h)	27
III VC 6,000 ppm.	72	-	5	3	11	1 (d)	1 (i)	21
IV VC 2,500 ppm.	74	-	2	6	9	3 (e)	1 (l)	21
V VC 500 ppm.	67	-	3	3	7	2 (f)	1 (m)	16
VI VC 250 ppm.	67	1	-	5	2	2 (g)	2 (n)	11
VII VC 50 ppm.	64	3	-	-	-	-	-	-
VIII No treatment	68	1	-	-	-	-	-	-
TOTAL	577	5	23	20	35	8	10	96

a) Metastases to lung.

b) Metastases to liver and/or to lung and spleen.

c) Metastases to lung.

d) Angiosarcomas in subcutaneous fibrosing angioma.

e) 2 intrabdominal angiosarcomas (1 next to spleen and 1 next to ovary); 1 ossifying angiosarcoma of neck.

f) 1 pulmonary angiosarcoma; 1 angiosarcoma of uterus.

g) 1 intrabdominal angiosarcoma (next to spleen); 1 intrathoracic ossifying angiosarcoma.

h) 2 Zymbal glands adenomas; 1 neurilemmoma of the ear; 1 mammary carcinoma; 1 cystoadenocarcinoma of ovar

i) Sebaceous gland carcinoma of skin.

l) Zymbal glands adenoma.

m) Minimal deviation hepatoma.

n) 1 Zymbal glands adenoma; 1 salivary glands carcinoma.

A Proportional Mortality Study of Workers Exposed to Vinyl Chloride 1947-74

by

Bernard S. Pasternack, Ph.D.

SUMMARY

The mortality experience of 433 employees who worked at The Firestone Tire & Rubber Company Pottstown complex and died during the period 1947-74 has been examined. Eighty-five of the 433 deceased employees worked in the chemical plant or plastics plant and were exposed to vinyl chloride; the remaining 348 worked in the tire plant and were not exposed to vinyl chloride. Death certificates were obtained for all 433 employees and the cause of death was coded according to the 8th revision of *The International List of Diseases and Causes of Death (1967)* by Michael Baden, M.D. Twelve additional employees have been identified as having died in the period 1947-74 (2 exposed and 10 nonexposed) but cause-of-death information was not available for these employees at the time of this analysis. The 445 employees who died since 1947 includes all workers who died while employed by Firestone or after their retirement. In addition, Firestone identified all of the employees who worked at Pottstown since 1947, had at least three years exposure to vinyl chloride, and terminated for some reason other than death or retirement. Of the 228 employees in this category (out of a total of 750 employees known to have worked in either the chemical plant or plastics plant), Firestone was able to trace all but 18 (8%) and verify that they are

still alive (207 or 91%) or deceased (3 or 1%). No follow-up was performed on nonexposed ex-employees.

There was an excess of malignant neoplasms in both the exposed and nonexposed employees, and a statistically significant excess in major cardiovascular deaths in the nonexposed employees, compared with the U.S. male population (1968) adjusted for age at death (Table 1). Comparison of the exposed employees with the nonexposed employees shows a slight excess in malignant neoplasms and a small deficit in major cardiovascular deaths in the exposed (Table 2)--neither statistically significant. Further comparisons involving 4 subgroups of the exposed employees (< 10 years work exposure; ≥ 10 years work exposure; "low" level exposure; "medium" level exposure) show no significant differences between observed and expected deaths (Tables 3-8).

Two findings should be stressed:

(1) One death due to angiosarcoma of the liver was confirmed in an employee, classified as having had "medium" level exposure, who died in 1969 at the age of 51--21 years after first exposure to vinyl chloride (with 19.4 years of work exposure). This single angiosarcoma death was the same one previously identified (independently) by Firestone.

(2) The ages-at-death were significantly lower in the exposed employees compared with the nonexposed employees ($P < .05$); the mean (± S.D.) ages of death being 55.3 (± 13.1) - exposed and 59.5 (± 14.6)-nonexposed (Tables 9 and 10). In particular, 21 out of the 22 deaths due to malignant neoplasms (95.5%) for the exposed employees occurred at ages < 65 compared with 44 out of 73 (60.3%) for the nonexposed. This difference is statistically significant at the 0.01 probability level. On the other hand, 32 out of the 46 deaths due to major cardiovascular diseases (69.6%) for the exposed employees occurred at ages < 65 compared with 121 out of 218 (55.5%) for the nonexposed--a

difference that is not statistically significant. Thus, the earlier ages noted for the cancer deaths in the exposed group of employees may not be solely attributable to a presumably younger cohort at risk.

TABLE 1.-Observed and expected† number of deaths due to selected causes among exposed and nonexposed employees, 1947-74

Cause of death	List No.††	Observed (and expected) deaths	
		Exposed	Nonexposed
Malignant neoplasms	140-209	22(15.4)	73(61.1)
Digestive	150-159	8(4.3)	24(17.5)
Liver	155	1	3
Respiratory system	160-163	8(5.4)	25(19.9)
Urinary organs	188-189	1(0.8)	3(3.5)
Brain	191	1	3
Lymphatic and hematopoietic	200-209	1(2.1)	7(7.8)
Other	---	3	11
Major cardiovascular	390-448	46(41.1)	218(178.5)**
Cirrhosis of liver	571	3(1.8)	4(5.7)
Accidents	800-949	8(8.0)	21(28.9)
Suicides	950-959	0(2.5)	6(8.3)
All other causes	---	6(16.2)	26(65.5)
Total	0-989	85(85.0)	348(348.0)

†Age-adjusted expected numbers determined from relative frequency of specific causes of death among U.S. white males in 1968.

††Eighth revision of *International List of Diseases and Causes of Death, 1967.*

**Statistically significant difference ($P < 0.01$).

TABLE 2.-Observed and expected† number of deaths due to selected causes, with chi-square values, among exposed employees, 1947-74

Cause of death	List No.‡	Number of deaths		Mantel-Haenszel summary Chi-square values
		Observed	Expected	
Malignant neoplasms	140-209	22	19.4	0.36
Digestive	150-159	8	6.5	0.23
Liver	155	1	1.0	0.33
Respiratory system	160-163	8	6.8	0.11
Urinary organs	188-189	1	0.7	0.09
Brain	191	1	1.0	0.33
Lymphatic and hematopoietic	200-209	1	1.9	0.00
Other	---	3	2.5	-
Major cardiovascular	390-448	46	50.5	1.08
Cirrhosis of liver	571	3	1.6	0.65
Accidents	800-949	8	6.7	0.18
Suicides	950-959	0	1.1	0.46
All other causes	---	6	5.7	-
Total	0-999	85	85.0	-

†Age-adjusted expected numbers determined from relative frequency of specific causes of death among the 348 nonexposed employees, with adaptation of the Mantel-Haenszel procedure.

‡See footnote, table 1.

TABLE 3.-Observed and expected† number of deaths due to selected causes, with chi-square values, among employees with < 10 years work exposure, 1947-74

Cause of death	List No.‡	Number of deaths		Mantel-Haenszel summary Chi-square values
		Observed	Expected	
Malignant neoplasms	140-209	16	12.2	1.37
Digestive	150-159	6	4.0	0.71
Liver	155	0	0.6	0.01
Respiratory system	160-163	7	4.5	1.17
Urinary organs	188-189	0	0.8	0.23
Brain	191	0	0.6	0.01
Lymphatic and hematopoietic	200-209	1	1.4	0.02
Other	---	2	0.6	-
Major cardiovascular	390-448	26	31.0	2.10
Cirrhosis of liver	571	1	0.9	0.25
Accidents	800-949	7	4.9	0.87
Suicides	950-959	0	0.8	0.13
All other causes	---	3	3.2	-
Total	0-999	53	53.0	-

†See footnote, table 2.

‡See footnote, table 1.

TABLE 4.-Observed and expected[†] number of deaths due to selected causes, with chi-square values, among employees with ≥ 10 years work exposure, 1947-74

Cause of death	List No.[‡]	Number of deaths		Mantel-Haenszel summary Chi-square values
		Observed	Expected	
Malignant neoplasms	140-209	6	6.8	0.01
Digestive	150-159	2	2.2	0.04
Liver	155	1	0.4	0.05
Respiratory system	160-163	1	2.2	0.26
Urinary organs	188-189	1	0.3	0.08
Brain	191	1	0.4	0.05
Lymphatic and hematopoietic	200-209	0	0.7	0.05
Other	---	1	1.0	-
Major cardiovascular	390-448	20	20.2	0.01
Cirrhosis of liver	571	2	0.5	1.88
Accidents	800-949	1	1.7	0.04
Suicides	950-959	0	0.5	0.00
All other causes	---	3	2.3	-
Total	0-999	32	32.0	-

[†]See footnote, table 2.

[‡]See footnote, table 1.

TABLE 5.-Observed and expected† number of deaths due to selected causes, with chi-square values, among employees with < 10 years work exposure, 1947-74

Cause of death	List No.†	Number of deaths		Mantel-Haenszel summary Chi-square value
		Observed	Expected	
Malignant neoplasms	140-209	16	14.8	0.15
Digestive	150-159	6	5.5	0.00
Liver	155	0	0.7	0.15
Respiratory system	160-163	7	5.2	1.12
Urinary organs	188-189	0	0.7	0.15
Brain	191	0	0.7	0.06
Lymphatic and hematopoietic	200-209	1	0.7	0.28
Other	---	2	2.0	-
Major cardiovascular	390-448	26	26.9	0.04
Cirrhosis of liver	571	1	1.7	0.07
Accidents	800-949	7	5.7	0.48
Suicides	950-959	0	0.0	0.00
All other causes	---	3	3.9	-
Total	0-999	53	53.0	-

†Age-adjusted numbers determined from relative frequency of specific causes of death among the 32 employees with ≥ 10 years work exposures, with adaptation of the Mantel-Haenszel procedure.

†See footnote, table 1.

TABLE 6.-Observed and expected† number of deaths due to selected causes, with chi-square values, among employees in the "low" level exposed group, 1947-74

Cause of death	List No.‡	Number of deaths		Mantel-Haenszel summary
		Observed	Expected	Chi-square values
Malignant neoplasms	140-209	11	10.2	0.01
Digestive	150-159	3	3.4	0.42
Liver	155	1	0.5	0.00
Respiratory system	160-163	4	3.6	0.00
Urinary organs	188-189	1	0.3	0.28
Brain	191	1	0.5	0.00
Lymphatic and hematopoietic	200-209	0	1.2	0.11
Other	---	2	1.2	-
Major cardiovascular	390-448	26	27.6	0.13
Cirrhosis of liver	571	2	1.0	0.35
Accidents	800-949	7	4.6	1.15
Suicides	950-959	0	0.8	0.12
All other causes	---	1	2.8	-
Total	0-999	47	47.0	-

† See footnote, table 2.

‡ See footnote, table 1.

TABLE 7.-Observed and expected† number of deaths due to selected causes, with chi-square values, among employees in the "medium" level exposed group, 1947-74

Cause of death	List No.‡	Number of deaths		Mantel-Haenszel summary Chi-square values
		Observed	Expected	
Malignant neoplasms	140-209	11	8.6	0.62
Digestive	150-159	3	2.8	0.03
Liver	155	1	0.5	0.00
Respiratory system	160-163	4	2.9	0.14
Urinary organs	188-189	1	0.4	0.03
Brain	191	1	0.5	0.00
Lymphatic and hematopoietic	200-209	0	0.9	0.19
Other	---	2	1.1	-
Major cardiovascular	390-448	20	23.9	1.52
Cirrhosis of liver	571	1	0.5	0.00
Accidents	800-949	1	1.9	0.11
Suicides	950-959	0	0.5	0.00
All other causes	---	5	2.6	-
Total	0-999	38	38.0	-

†See footnote, table 2.

‡See footnote, table 1.

TABLE 8.-Observed and expected† number of deaths due to selected causes, with chi-square values, among employees in the "low" level exposed group, 1947-74

Cause of death	List No.‡	Number of deaths		Mantel-Haenszel summary Chi-square values
		Observed	Expected	
Malignant neoplasms	140-209	11	12.5	0.25
Digestive	150-159	5	4.6	0.00
Liver	155	0	0.5	0.00
Respiratory system	160-163	4	4.4	0.00
Urinary organs	188-189	0	0.6	0.01
Brain	191	0	0.5	0.00
Lymphatic and hematopoietic	200-209	1	0.7	0.28
Other	---	1	1.7	-
Major cardiovascular	390-448	26	24.0	0.48
Cirrhosis of liver	571	2	1.5	0.00
Accidents	800-949	7	5.3	1.01
Suicides	950-959	0	0.0	0.00
All other causes	---	1	3.7	-
Total	0-999	47	47.0	-

†Age-adjusted numbers determined from relative frequency of specific causes of death among the 38 employees in the "medium" level exposed group, with adaptation of the Mantel-Haenszel procedure.

‡*See* footnote, table 1.

Table 9.-Distribution of deaths by age and cause for exposed and nonexposed employees, 1947-74

Cause of Death	List No.*	Group†	Age at Death					
			≤ 34	35-44	45-54	55-64	≥ 65	Total
Malignant neoplasms	140-209	E	0	3	5	13	1	22
		NE	0	11	15	18	29	73
Digestive	150-159	E	0	1	3	4	0	8
		NE	0	2	6	5	11	24
Respiratory system	160-163	E	0	1	0	6	1	8
		NE	0	5	3	8	9	25
Urinary organs	188-189	E	0	0	1	0	0	1
		NE	0	0	0	1	2	3
Lymphatic and hematopoietic	200-209	E	0	1	0	0	0	1
		NE	0	0	4	2	1	7
Major cardiovascular	390-448	E	0	4	19	9	14	46
		NE	3	13	47	58	97	218
Cirrhosis of liver	571	E	0	0	1	1	1	3
		NE	0	1	2	1	0	4
Accidents	800-949	E	4	1	3	0	0	8
		NE	11	4	5	0	1	21
Suicides	950-959	E	0	0	0	0	0	0
		NE	1	2	1	0	2	6
All other causes	---	E	0	3	1	1	1	6
		NE	3	3	4	2	14	26
Total	0-989	E	4	11	29	24	17	85
		NE	18	34	74	79	143	348

†E = Exposed.
NE = Nonexposed.

*See footnote, table 1.

TABLE 10.-Distribution of age at death by year of death for exposed and nonexposed groups

Year of Death	Group†	Age at Death ≤ 34	35-44	45-54	55-64	≥ 65	Total
1947-54	E	1	0	0	0	0	1
	NE	8	3	11	8	3	33
1955-59	E	1	3	3	1	0	8
	NE	4	7	9	8	17	45
1960-64	E	0	2	10	6	1	19
	NE	2	11	14	16	31	74
1965-69	E	1	3	9	6	3	22
	NE	2	10	23	18	39	92
1970-74	E	1	3	7	11	13	35
	NE	2	3	17	29	53	104
Total	E	4	11	29	24	17	85
	NE	18	34	74	79	143	348

† E = Exposed
NE = Nonexposed

1984

MICHAEL M. BADEN, M.D.
520 FIRST AVENUE
NEW YORK, NEW YORK 10016

1917

June 19, 1974

Mr. Arthur Smith
39 South Lasalle Street
Chicago, Illinois 60603

Dear Mr. Smith:

I have reviewed 433 death certificates and the vinyl chloride exposure records of 445 employees identified by the Firestone Company as the total number of workers at the Pottstown complex who have died since 1947. Included are 85 of 87 employees who were exposed to vinyl chloride. Thus 97.3% of all deaths and 97.7% of the vinyl chloride exposed deaths were examined. Hospital records and histologic slide material were reviewed by me when indicated.

The major findings can be separated into four categories:

1. Angiosarcoma: One angiosarcoma of the liver was identified (which I had not known was previously known to Firestone) and no other angiosarcomas were found among the 433 decedents. This tumor occurred in a 51 year old male in the long exposure higher concentration group 21 years after initial exposure. A single tumor, even a rare one such as angiosarcoma of the liver, can occur spontaneously and, by itself, its significance cannot be properly evaluated. However, when considered together with other data presently available which was not known at the time of the death in 1969, including recent animal studies and reports of angiosarcomas in vinyl chloride exposed persons elsewhere, it appears that this angiosarcoma is consequent to the vinyl chloride exposure.

2. Malignancy in general: There was no significant increase in deaths from any specific malignancy in the exposed and non-exposed employees as demonstrated by Dr. Bernard Pasternak's statistical evaluations. A slight excess of cancers of the respiratory and digestive systems present in both groups when compared to the total United States white male population must be further examined as to smoking habits of these groups and other local environmental factors (including fads among physicians in determining cause of death in non-autopsied fatalities.) This examination should include evaluation of Pottstown employees who are still alive. Such evaluation of living employees is also necessary to further evaluate the finding by Dr. Pasternak, on the basis of information presently available, that the mean age of death from all causes of exposed employees (55.3 years) was less than for non-exposed employees (59.5 years). There may be reasons for this difference other than exposure to vinyl chloride.

The median age of death of those dying of cancer in the exposed group (22/85) is the same as the median age of death of those dying of cancer in the non-exposed group (73/318) -- 58 years). There is no greater number of early deaths from cancer in the exposed group. However, in the exposed group the oldest death from cancer was 67; in the non-exposed group 19 deaths from cancer occurred between 71 and 87 years of age. This difference may be an artifact caused by initial population age differences but should be explored further. There is no difference in all causes of death among the 32 decedents exposed to vinyl chloride for more than 10 years as compared to the 53 decedents who had briefer exposure; and among the 22 malignancies in the exposed group there is no difference in type of cancer in those exposed more or less than 10 years (except for the one angiosarcoma in the longer exposed group).

3. Cirrhosis of the liver: The three fatalities attributed to cirrhosis of the liver in the exposed population and four in the non-exposed population may be accounted for on the basis of alcohol consumption, a highly significant factor in evaluating the etiology of cirrhosis and a factor which is noticably not mentioned in the medical charts I was able to examine.

4. The Tabershaw and Gaffey study: This mortality study, a draft of which I reviewed which may not be the final report, evaluates mortality rates employing data on living as well as dead employees exposed to vinyl chloride in 34 plants. 8384 workers were identified of which 352 were known to have died and 328 death certificates were reviewed (in 1256 or 15% of the workers they had not yet been able to determine whether the individual was still alive). Dr. Tabershaw states that "This is the first epidemiological study which suggests that in humans vinyl chloride may also be associated with cancer of multiple sites." (The only published report he refers to in support of this concern is work by Viola in which "large doses of the chemical in rats produced cancer of the skin, lung and other organs." When Viola's work was reviewed by Maltoni, the latter concluded that these were not primary cancers but were metastases from Zymbal gland tumors which tumors are produced by a large variety of carcinogens and are not specific for vinyl chloride.) Dr. Tabershaw's data suggests that in humans vinyl chloride exposure may cause an increase in cancers of the digestive system (primarily angiosarcomas), respiratory system (primarily lung cancer), brain, unknown sites and in lymphosarcoma: lung cancer - this is the most common fatal malignancy in males in the United States; there was a slight excess of this tumor in the Firestone population in both the exposed and non-exposed groups. The significance of this finding can only be evaluated after obtaining adequate smoking histories.

Brain cancer - there was only one death from a brain tumor in the exposed Firestone group and there were three in the non-exposed group. As Dr. Tabershaw indicates deaths diagnosed as due to primary brain cancers may include metastatic cancers from other undiagnosed primary sites, especially from the lung. (In only one of Dr. Tabershaw's six cases is an autopsy listed as having been performed).
Lymphosarcoma - there was only one death from lymphosarcoma indicated on the death certifications in the exposed Firestone group. On further review of this decedent's medical records (after Dr. Pasternak's study was completed) it became apparent that the cause of death was not a lymphoma but rather . a metastatic cancer, probably from the trachea. This demonstrates the necessity of not accepting death certificates at face value. Dr. Tabershaw found six lymphosarcomas in his study which apparently was limited to a review of the death certificates.
Cancer of unknown sites - includes many different types of cancer and cannot be evaluated without reviewing each decedent's medical and autopsy records.

The above represents a preliminary evaluation of vinyl chloride exposed and non-exposed employees from the Pottstown Firestone plant who have died. This group should be evaluated together with employees who have not died so that mortality incidences can be determined and maximal information can be obtained. This further study should include information as to smoking and alcohol habits.

The issue of threshold still remains to be resolved but there may be a level beneath which exposure to vinyl chloride is not harmful.

Sincerely,

Michael M. Baden, M.D.

MMB:fp

1360

EVALUATION OF THE IMPACT OF THE PROPOSED OSHA REGULATION RELATING TO ALLOWABLE EXPOSURE TO VINYL CHLORIDE IN THE WORKING ENVIRONMENT

FOR

FIRESTONE PLASTICS CO.
Division of the Firestone Tire & Rubber Co.
Pottstown, Penna. 19464

Prepared by Frederick B. Higgins, Jr., Ph.D., P.E.
Chairman of Environmental Engineering Technology
Temple University, Phila., Pa.

In conjunction with:

WASTEX INDUSTRIES, INC.
Environmental Consultants
Industrial Valley Bank Building
23 S. Hanover Street
Pottstown, Pa. 19464

June 15, 1974

EVALUATION OF THE IMPACT OF THE PROPOSED OSHA REGULATION RELATING TO ALLOWABLE EXPOSURE TO VINYL CHLORIDE IN THE WORKING ENVIRONMENT

ABSTRACT

Evidence has accumulated indicating that vinyl chloride is potentially carcinogenic to humans. On May 10, 1974 OSHA proposed a new standard limiting air concentrations to a "no detectable concentration" (1 ppm).

This limited study concludes that achievement of this standard at the Pottstown Plant, Firestone Plastics Co. is virtually not possible through modifications to the plant. A level of 10 ppm TWA may be achievable but at least three years will be required to make the necessary engineering studies and complete constructions.

It is recommended that an interim standard and a revised permanent standard be proposed to OSHA.

EVALUATION OF THE IMPACT OF THE PROPOSED OSHA REGULATION RELATING TO ALLOWABLE EXPOSURE TO VINYL CHLORIDE IN THE WORKING ENVIRONMENT

1322

INTRODUCTION

During the last several years, evidence has accumulated indicating that vinyl chloride is potentially carcinogenic to humans. This trend culminated in an announcement by O.S.H.A. on January 22, 1974, that they had been informed by N.I.O.S.H. of the occurrence of several cases of angiosarcoma (a rare form of liver cancer) among the employees of Goodrich's Louisville, Ky. plant. Subsequently, an intensive industry search has revealed a total of 19 cases, worldwide, among employees working in the vinyl chloride or polyvinyl chloride industry. Following hearings into the carcinogenicity of vinyl chloride, O.S.H.A. reduced the ceiling for exposure to vinyl chloride vapors from 500 ppm to 50 ppm ceiling effective April 5, 1974, on an emergency, interim basis.

On May 10, 1974, O.S.H.A. published in the Federal Register a proposed permanent standard for the regulation of vinyl chloride exposures. The most essential features of the proposed standard are:

1. To limit air concentrations in the working place to "no detectable concentration", based on an analytical sensitivity of 1 ± 0.5 ppm.
2. Where detectable levels are found, engineering and work practice changes would be expected to reduce concentrations below the detectable level.
3. While concentrations were being reduced, those portions of the plant where measurable concentrations could be found would be classified as "restricted areas" and all personnel entering would be required to wear full protective gear and supplied air masks.

On May 24, 1974, Westex Industries, Inc., was retained by the Firestone Plastics Co. to determine the impact of the proposed 1923
O.S.H.A. regulation on it's polyvinyl production facility in Pottstown, Pennsylvania. The objectives of the study were:

1. To determine the feasibility of meeting the "no detectable concentration" standard.
2. In the event of positive feasibility, how much time would be required to meet the standard.
3. In the event of negative feasibility, what alternative standard would allow for continued operation of the plant and be responsive to employee safety.

PROCESS AND PLANT INFORMATION

This report is based on existing statistical and engineering information, which was supplied by Firestone personnel, and was supplemented by site inspections and discussions with operating personnel. Existing data included plant layouts, capacity information, process diagrams, identification of vinyl chloride emission points, and the results of extensive personnel exposure monitoring conducted during April and May 1974 in accordance with the O.S.H.A. temporary standards.

The Firestone polyvinyl chloride plant in Pottstown produces two basic types of PVC products and in addition produces some styrene/ butadiene polymer. Production consists of an average of 8-10 million pounds per month of dispersion type (fine powder) resin and 4-6 million pounds per month of suspension (type) resin. All of the dispersion polymer and approximately one-half of the suspension polymer is bagged. The remainder of the suspension resin is shipped in bulk. For convenience in discussion of plant activities, the processes will be broken into the three categories below:

1. Vinyl Chloride Receipt, Storage and Handling

The vinyl chloride monomer is received in pressurized tank cars in liquid form. Vinyl chloride boils at -13.8°C at one atmosphere and has a vapor pressure 35 psig at 68°F. The contents of each car is sampled and transferred by pipeline into storage tanks. From the storage tanks, the vinyl chloride is transferred into refrigerated tanks (to reduce vapor pressure) prior to pumping into weigh tanks located in reactor buildings 1 and 2.

2. Polymerization

In the polymerization process, the coarse (suspension) resins and fine (dispersion) resins are produced by differing reaction conditions in different process equipment. Suspension resin is produced by weighing a mixture of monomer, suspending agent, water, catalyst and minor ingredients into a glass-lined reactor vessel. The reactor vessel is stripped of air and pressurized to approximately 100 psi. After several hours of reaction time under agitation, the charge is dropped into a stripper vessel where steam and vacuum are used to reduce the residual monomer content of the resin particles. Following stripping, the batch is screened and pumped to an agitated blend tank. After blending to specifications, the polymer slurry is centrifuged and the cake is dried in a rotary dryer. The dry powder is then pneumatically conveyed to a secondary collector, screened and binned. The bins may feed by gravity to a bagging machine, or pneumatically to elevated bulk storage bins.

Dispersion resin is produced in similar fashion except that the liquid monomer is emulsified and the batch formulated in a charge vessel prior to pumping through a homogenizer into the reactor. The product is similarly blended and then spray dried. The fine powder is collected in baghouses, screened, ground and bagged.

The vinyl chloride vapors removed in the stripping process are recovered by Carnea Oil absorption and re-purified for further use. The facility for this purpose is detached from the main plant building and is located in the monomer storage area.

3. Product Handling, Storage and Shipment

Bagged materials are palletizied, compressed and stored in a warehouse area prior to shipment by truck or boxcar. Bulk materials are stored in elevated tanks for pneumatic loading into bulk railcars.

The Firestone plant was put into operation in 1947 with 10 vinyl chloride reactors. Since that time, it has been expanded in stages to a total of 65 reactors, of which 61 are normally in vinyl chloride service and 4 are used to produce styrene/butadiene polymer. Since vinyl chloride was considered to be relatively non-toxic during the period of construction, normal chemical processing industry construction practices were followed. As a result, the plant appears crowded by present standards and contains numerous points of potential leakage such as at pipe flanges and around valve stems. The leakage problem is compounded by the high vapor pressure of vinyl chloride polymer, and by vibration from the many pumps, compressors, agitators and vacuum pumps located throughout the plant.

Maintenance of a clean VCM working environment is further complicated by the retention of vinyl chloride monomer in the polymer granules. Although much of the retained monomer is removed under

heat and vacuum in the stripper vessel, complete removal is incompatible with production of a marketable product, since the polymer is heat sensitive. However, in storage, the residual vapor diffuses out of the polymer and creates small but measurable air concentrations. The amount and diffusion rate of retained vinyl chloride varies with the size and density of polymer resins. However, some typical results are shown in Table 1.

1928

TABLE 1

RETENTION OF VINYL CHLORIDE VAPORS

IN POLYMER

Initial Concentration (ppm)	Final Concentration (ppm)	Time of Storage (days)
1000	565	47
15	15	14
3	1	14
26	1	14
84	2	14
410	133	14

EXPOSURE LEVELS IN EXISTING FACILITIES

An intensive survey of personnel exposures, air concentrations and leak detection has been conducted by Firestone personnel starting in April, 1974. Data through the month of May, consisting of 10 minute breathing zone samples of workers, whose names start with A through K, have been summarized by job category in Table 2. It may be seen that all production and maintenance personnel are currently being subjected to vinyl chloride concentrations of a detectable level, but averaging less than the interim emergency standard level of 50 ppm. Evidence is available to indicate that routine values of greater than 1 ppm exist in all areas of the plant. The proposed standard would thus necessitate that the entire plant premises be considered a restricted area and that supplied-air masks and full protective gear would be required for all personnel.

1928

Jobs where exposure levels may exceed 50 ppm and where masks are currently required are listed below. Remedial action is planned or underway for all sources:

1. Building 2-1st level. Pumping heels out of stripper tanks through screens (once/day).
2. Building 2-2nd level same area. Drain knockout pots before compressors and on horizontal cushion tanks (once/shift).
3. Building 1-3rd floor. Reactors 1-5 are in process of being fitted with drop-line ventilation systems. Mask during charging and flushing.
4. Building 1-2nd floor. Mask during sampling when charges are dropped to stripper (suspension resin only).
5. Tank Farm. Inside of the unloading pump house.
6. Building 1. Cleaning discharge valves on reactors.

7. Flushing of systems because of plugged drop valve or discharge line on reactors.

8. Flushing of blend tanks upon product change. 1323

9. Laboratory sampling of the contents of vinyl tank cars.

10. Laboratory sampling of the contents of vinyl chloride storage tanks.

TABLE 2

SUMMARY OF WORKER EXPOSURE DATA

Job Title	No. Men	No. Samples	Average Concentration (ppm)	No. Samples >5ppm	>10ppm	>20ppm	>50ppm
Engineer or Manager	11	13	8.9	6	3	2	0
Foreman	12	17	8.8	11	6	0	0
Reactor Operator	18	168	36.8	154	117	59	17
Relief Operator	8	41	29.7	28	14	6	3
Dryer Operator or Bagger	19	68	6.4	23	9	5	1
Centrifuge Operator	9	28	4.4	9	2	0	0
Stripper Operator	7	67	25.0	45	29	19	9
Tank Farm Operator	2	19	36.8	19	15	10	1
Trucker (Forklift)	7	15	5.0	4	3	1	0
Supplies (mixing solutions in reactor building)	2	13	12.6	13	9	0	0
Service and Utility	13	39	18.4	21	16	12	5
Maintenance	36	84	19.4	54	40	19	7
Janitor	6	11	8.6	4	4	2	0
Painter	1	1	1.5	0	0	0	0
Laboratory	17	35	10.6	8	4	3	2

E980

In order to assess the feasibility of achieving concentrations of vinyl chloride in air of less than one ppm, the emission points within each plant area have been identified and summarized in Table 3. Where the source is capable of producing atmospheric concentrations exceeding 50 ppm, this fact is indicated. In addition, where emissions reduction appears technically practical and remotely feasible from an economic standpoint, the source is keyed to an abatement project number. The possible abatement action numbers are enumerated in in Table 3 and described in the next section.

TABLE 3

SOURCES OF VINYL CHLORIDE EMISSION TO AMBIENT AIR

	POSSIBLE ABATEMENT ACTION NUMBER
I. TANK FARM	
A. Rail Car unloading	
1. Gasketing at hose connections	none
*2. Pump seals	1 or 2
*3. Compressors	1 or 2
4. Flanges at pipe joints	3
*5. Valves leaking	4
6. Venting pressure off hoses before disconnecting	5
*7. Lab sampling of vinyl chloride cars	6
B. Transfer Operations (From 25,000 gallon storage tanks, to sphere, to refrigerated storage tanks, to weigh tanks)	
1. Pipe flanges	3
*2. Pump seals	1 or 2
*3. Valves Leaking	4
*4. Compressors	1 or 2
*5. Lab sampling of stored vinyl chloride	6
6. Airing out tanks for pressure inspection or cleaning	none
II. POLYMERIZATION BUILDING - REACTOR ROOM	
*A. Pump seals	1 or 2
B. Flanged pipe joints or vessel connections	3
*C. Reactor heads	7
D. Reactor seals	7
*E. Valves Leaking	4
*F. Opening reactor heads for flushing	7
*G. Flushing reactors	7
*H. Cleaning reactors	7
*I. Cleaning build up from valves, lines, etc.	none
J. Maintenance of various equipment	varies
K. Airing out equipment in preparation for entry	7
L. Operator errors	none
*M. Plugged lines resulting in gasket failure	none
N. Ventilation of reactors during flushing operation (vapors discharged on roof)	none
*O. Airing out vessels containing poorly degassed material as a result of plugged discharge line, set up, etc.	7
P. Purging of reactors prior to charging (vapors discharged on roof)	none

*Areas of actual or potential exposure of 50 ppm vinyl chloride or higher that pose problems because of exposure frequency or high exposure level.

1963

III. POLYMERIZATION BUILDING - STRIPPER LEVEL

*A.	Sampling of unstripped suspension resin batches	none
*B.	Pump seals, homogenizer leakage, etc.	1 or 2
C.	Leaking valves	4
D.	Leaking gaskets at pipe flanges	3
*E.	Airing out reactors for cleaning and during cleaning	7
*F.	Plugged lines resulting in gasket failure	none
*G.	Spills resulting from unplugging of stopped lines	none
H.	Operator errors	none
I.	Purging of stripping vessels (vapors discharged on roof)	none
J.	Maintenance work on pumps, homogenizers, cleaning discharge valves, etc.	none

IV. POLYMERIZATION BUILDING - PUMP OUT LEVEL (RELIEF AREA)

*A.	Screening operation to remove coarse chunks of resin	8
B.	Leaking pump seals	1 or 3
*C.	Compressor leakage	1 or 3
D.	Leaking pipe flanges resulting in spills	none
*E.	Open vibrating screens	8
F.	Leaks in closed screening operation	none
*G.	Drains from top two floors	9
*H.	Process water containing dissolved vinyl chloride discharging inside building	10
*I.	Draining of foam traps on compressors	2
*J.	Draining water off the condensed recovered vinyl chloride	2
K.	Moving screen overflow outside building and dumping drums	none

V. BLEND TANK AREA (WORK-IN-PROCESS STORAGE)

A.	Monomer evolution during storage	11
*B.	Flushing blend tanks	none
C.	Leaks (pump seals, hoses, pipe flanges)	1,2,3 or 4

VI. SPRAY DRYING OPERATION

A.	Spray dryer exhaust air (100 to 500 ppm)	none
B.	Latex leaks from pump seals, pipe flanges	1,2,3
*C.	Screening operation prior to atomization	2
D.	Any operation involving finished resin or where dried resin accumulates. Dried resin contains approximately 10 ppm residual monomer.	
	1. Bagging	12
	2. Housekeeping	12
	3. Dried product screening	12
	4. Changing dust collector bags	12
	5. Cleaning equipment	12

*Areas of actual or potential exposure to 50 ppm vinyl chloride or higher that pose problems because of exposure frequency or high exposure level.

VII. ROTARY DRYING OPERATION

A.	Rotary dryer exhaust air (approximately 50 ppm)	none
B.	Leaks from pump seals, pipe flanges	1,2,3, or 4
C.	Centrifuge liquid discharge (effluent)	10
D.	Any operation involving handling or storage of finished resin or where dried resin accumulates. Dried resin generally contains less than 100 ppm for the porous types, less than 500 ppm for the high bulk density types, and as high as 3000 ppm for two specialty types.	
1.	Bagging	12
2.	Housekeeping	12
3.	Dried product screening	12
4.	Changing dust collector bags	12
5.	Cleaning equipment	12
6.	Pneumatic transfer of resin to storage or into bulk trucks and rail cars	12
7.	Maintenance operations in areas where masses of resin are stored, primarily silos.	12

VIII. WAREHOUSE AREAS

A.	Any area where resin is stored in a manner that restricts air circulation.	
1.	Plastic shrouded pallets	12
2.	Resin in sealed drums or boxes, etc.	12
3.	Resin in semi-bulk containers (metal tote bins, etc.)	12
B.	There are low, but measurable, levels of vinyl chloride wherever resin is stored in bags from gradual evolution of residual vinyl chloride.	12

IX. LAB AREAS

A.	Testing of finished resin	12
*B.	Testing of resin slurry prior to drying (suspension resins)	12
*C.	Testing of monomers in Control Lab and Analytical Lab	12

*Areas of actual or potential exposure to 50 ppm vinyl chloride or higher that pose problems because of exposure frequency or high exposure levels.

1. Replacement of Pumps and Compressors with Low Leakage Types

Due to the large number of pumps and compressors required, complete replacement would be extremely expensive. Local exhaust of all points of leakage as discussed in Item 2 would probably be more practical.

2. Local Exhaust at Emission Points

Local exhaust has been used to control emissions at pump and compressor seals in the Firestone plant. This principle could be extended to many additional points of small, but more or less continuous emissions to the plant air. Considerable ductwork would be required along with substantial air volume requirements. However, extensive, if not complete, collection should be economically feasible.

3. Use of Welded Pipe Construction

The elimination of flanged pipe joints on vinyl chloride containing lines would eliminate a substantial amount of leakage. However, all pipes containing monomer or polymer, tend to clog and require periodic cleaning. The elimination of pipe joints would make effective cleaning very difficult and would be of only limited practical application.

4. Replace Valves with Low Leakage Types

A program is underway to replace gate valves in vinyl service with ball valves possessing inherently lower leakage rates. This program could be accelerated, though at substantial cost due to the hundreds of valves used in the plant.

5. Venting of Tank Car Hoses

1336

Venting of tank car hoses before disconnecting could be better accomplished by pressure-relief and ventilation through a special fume system. A relief valve at the hose base could be connected into a small vacuum system with elevated exhaust. This would prevent discharge upon disconnecting and would also avoid the loss of vapors during hose storage.

6. Development of a low Emission Sampling System

At present, samples of monomer are collected from pressurized storage vessels and tank cars by blowing a stream into an open collection jar through a sampling valve. This could be improved by first flushing and then sampling through a low-loss fitting into evacuated cylinders. Development of such a system should be simple and economical.

7. Modify General Ventilation in Reactor Buildings

The present reactor buildings are exhausted by window fans using makeup air supplied from ground level for the first floor and from roof level for the second and third floors. The ventilation rate is set at 10 air changes per hour under normal conditions and can be boosted to 20 changes per hour in an emergency. The horizontal air flow pattern allows vapor concentrations to increase as the air passes over several reactors. If would be preferable to locate air intakes over individual or small groups of reactors to remove vapors as closely as possible to the point of emission. This would also allow vapors to be discharged above roof level to minimize interference with air intakes in the general vicinity.

8. Modify Screening at Strippers

1937

After stripping, the resin slurry is currently passed through an open screen prior to blending. The screening operation could be enclosed. However, maintenance would be difficult. A more practical and economical approach would involve provision of a hood and local exhaust system discharging above the roof.

9 & 10. Process Water Drains

At present, process water containing monomer is discharged through open floor drains on the lower floors. These could be enclosed, but it would be preferable to discharge contaminated water through a piping system routed to the outside of the building as directly as possible.

11. Extension of Storage Vents

At the current elevation, vents from the blend tanks allow fumes to re-enter the building through windows and air intakes. Although substantial cost would be involved, the vents could be connected into an exhaust system with a high level discharge.

12. General Ventilation

In certain areas of the plant, particularly where concentrations arise principally from diffusion of vapor from solid resins, vinyl chloride levels could be reduced substantially by installing or supplementing ventilation. The warehouse, drying, and bagging areas would be especially amenable to this approach. However, the cost of makeup air would be high.

In addition to the projects enumerated above, an additional undertaking which would materially assist in lowering vinyl chloride concentrations in the plant would be the vertical separation of air intakes and exhausts. At the present time, contaminated air is

discharged from many sources at relatively low elevations. The collection of ventilation system vapors for discharge through a high stack would avoid contamination of much of the ventilation air coming into the building. This project would be extremely expensive, but would be essential to any serious attempt to achieve the "no detectable concentration" level.

1938

ANALYSIS

Within the time frame and scope of this report, it is not possible to define the nature and extent of control systems and techniques which are both technically possible and which could be tolerated as an additional cost of conducting business. However, in the vinyl chloride industry, control to the "no detectable concentration" level in even a new plant would require pushing to the limits of available technology and represent an enormous cost. In the existing plant, physical restrictions and the heavy investment in major equipment would limit the application of many control techniques. Substantial improvement in air quality is attainable through careful engineering and construction, but the terms of the proposed regulation as written probably cannot be met technically in an existing plant and certainly cannot be met economically. Unless a further interim standard or a high permissable concentration is adopted, all plant employees would be required to wear supplied-air masks and protective gear during a reconstruction period of several years. This would make operation of the plant extremely difficult if not practically impossible. Obviously, shutdown of the polyvinyl chloride industry would produce severe disruption of the national economy.

CONCLUSIONS

1. Non-detectable (less than 1 ppm) levels of vinyl chloride in in-plant air cannot be achieved in new plant construction except by the introduction of special technology involving low leakage equipment, valves and piping, local and general ventilation, and special handling and storage techniques. 1980

2. Achievement of non-detectable levels of vinyl chloride in the existing Pottstown Plant, Firestone Plastics Co. is virtually impossible without, in effect, rebuilding the plant. The cost of this construction would probably exceed the cost of comparative new construction because of the restriction in space and the high cost of renovation construction. Such a cost is considered to be intolerable under present market conditions.

3. A level of 10 ppm on a time-weighted average basis might ultimately be achievable in existing PVC plants through construction of extensive and costly new ventilating collecting and exhausting systems, particularly in high concentration areas and through revised handling methods in transfer areas. However, on the basis of present technology, no definite forecasts can be made as to whether this low level can be attained. Whether such a low level is practical or achievable can be determined only after the new equipment and engineering procedures have been installed.

4. It is estimated that a period of at least three years will be required to engage in detailed engineering evaluation and design studies to construct the necessary facilities without interrupting production significantly and to perform a post-construction evaluation.

RECOMMENDATIONS

A further interim standard should be proposed for adoption by O.S.H.A. The standard should be effective for a three year period to provide time for engineering and installation of control equipment. The three year period would also allow for further, more comprehensive investigation of the toxicity of vinyl chloride. 1340

The terms of a permanent standard which could be accepted by the industry, although at high cost, should contain the following features:

1. The interim maximum concentration should be based on weighted average worker exposure rather than on air concentration.
2. In areas where the worker exposure exceeds 10 ppm, but does not exceed 50 ppm, cartridge-type masks and coveralls should be required. Coveralls should be removed and the employee should shower before leaving the restricted area.
3. In jobs involving exposure to greater than 50 ppm vapor concentration, or significant skin contact, supplied-air respirators and full protective gear should be required.

BRITISH EMBASSY
3100 Massachusetts Avenue, N.W.
WASHINGTON, D.C. 20008
Telephone: (202) 462-1340

RECEIVED
JUN 18 1974
W.B.C. Jr.

ECO 7/3/1

14 June 1974

Mr Walter B Connolly
Law Department
Firestone Rubber Company
1200, Firestone Parkway
Akron Ohio 44317

Dear Mr. Connolly,

You recently contacted this Embassy seeking information on United Kingdom action on vinyl chloride. Your specific query in connection with an article in the "Chemical Engineering News" has I think been answered but you may be interested to read the enclosed note which sets out the lines of action agreed between the UK Factory Inspectorate and the Employment Medical Advisory Service. I should, however, emphasise that the note sets out the position as at 25 March and is of course subject to amendment in the light of experience. If we receive any further information, we will let you know.

Yours sincerely,

P.W. Murphy.

(P W Murphy)
First Secretary
(Agricultural/Commercial)

Enc

PREVIOUS EXPERIENCE

It was not until the end of January 1974 that the Department of Employment (DE) learned, through the major UK manufacturers, ICI, BP, that there was suspicion that vinyl chloride monomer (VCM) might be carcinogenic. Prior to that time we have been aware of four cases of acro-osteolysis in autoclave workers at one factory where control of VCM vapour was less good than elsewhere, and also of several cases of collapse at the same factory following exposure to very high concentrations. We had accepted the recommendations of the ACGIH on threshold limit values, having reduced the TLV to 200 ppm in 1972, from the previous ceiling value of 500 ppm. Evidence of the absence of any cases of acro-osteolysis or of collapse at factories where the TLV was generally not exceeded tended to confirm the suitability of the value adopted.

Prior to January 1974, in fact, our main concern with VCM related to its flammability and the attendant explosion risk in its manufacture and use. Some of the precautions thus required (eg separation of processes, location of new plant outside) have served to limit the numbers of workers likely to be exposed to VCM in the atmosphere to a minimum.

EARLY ACTION

On 23 January 1974, the Chief Medical Officer of ICI informed the Chief Inspector of Factories and the Chief Employment Medical Advisor of the DE of the experimental evidence, of the news that cases of angio-sarcoma had been identified in PVC workers in the USA and that ICI had within the previous few days identified one retired employee who had died of angio-sarcoma at the age of 71, having worked on the process for over 20 years. The immediate advice of the Chief Inspector of Factories was that ICI should inform the workers and the other companies involved of the situation, and this they had already planned to do. Factory inspectors responsible for the six factories concerned were briefed and asked to visit to ensure that management were aware of the suspicions and that they were arranging to tell the workers affected. We have also maintained liaison with the Medical Advis r

to the Trades Unions Congress, and with the General Secretary of the Transport and General Workers Union. Copies of a written answer to a Parliamentary Question, and of a DE press release are attached for information.

In all the above action there was close co-operation between the Factory Inspectorate and the Employment Medical Advisory Service. The latter have given advice on the medical and experimental evidence, and have now met with the medical officers of the factories concerned to discuss the possibilities for early detection by screening of workers, and also the need for a more detailed survey of the exposed population.

Immediate environmental investigations were begun by the Factory Inspectorate, with a chemical inspector of factories from its Industrial Hygiene Unit visiting each of the major users to obtain at first-hand details of the processes used, knowledge of the areas and activities most likely to give rise to exposure to VCM, and to assess the potential for immediate and long-term improvement of environmental conditions. A copy of the summary of these visits dated 18/2/74 is attached for information. (As an internal report this is not published information and should be regarded as confidential.) The investigation indicated that at the six factories manufacturing PVC, a total of some 433 workers were directly employed in processes which were likely to cause exposure to VCM vapour. Indications so far are that the total number of workers likely to be exposed to significant concentrations of VCM in the UK is unlikely to be found to be significantly above this figure.

SUMMARY OF UK ENVIRONMENTAL EXPERIENCE

Exposure to VCM vapour occurs almost entirely in operations associated with the polymerisation of VCM in autoclaves. Apart from accidental discharges due to leaks, etc, exposure is at its greatest when the autoclave lids are opened at the end of the process for cleaning. In five factories the batch is run out and the autoclave ventilated before opening, but in one factory the lid is opened whilst the batch is still present, and although extraction ventilation is used, high levels of VCM in air are experienced for short periods, particularly by the worker opening the lid. Exposure during cleaning is also dependent on operating technique. The highest levels of

exposure are experienced where cleaning is by entry into the autoclave by one of the workers. The majority of plants, however, now use high pressure water jets to do the bulk of the cleaning and the occasions when entry is required are much fewer, and the time spent inside is much shorter.

FUTURE ACTION

The following immediate lines of action have been agreed between the Factory Inspectorate and the Employment Medical Advisory Service:-

(1) In the interim period to regard a figure of 50 ppm as a temporary hygiene standard. This decision is based largely on the experimental evidence that 50 ppm is a "nil response" level in rats. The figure is adopted with caution on the understanding that it is subject to reconsideration in the light of future experience.

(2) On the basis of this temporary standard to make recommendations to the factories concerned relating to conditions needing remedy in their particular plants. These would, broadly speaking, require the control of vapour in air to below 50 ppm, and the provision of fresh air breathing apparatus where exposure is likely to be above this level (eg during entry for cleaning purposes).

A close watch is to be kept on all the UK manufacturing plants, with the object of securing as rapid improvement as is possible. The Industrial Hygiene Unit has now begun estimation of concentrations of VCM in the atmosphere in and around the processes, using gas chromatography techniques.

The Employment Medical Advisory Service is taking forward proposals for a survey of workers exposed to VCM.

The Chemical Industries Association has set up in conjunction with the four major producers a Committee to consider the hazards to health arising from the use of VCM and the safeguards needed to control them. The Committee has 4 Working Groups dealing with medical matters, works practices, analytical procedures and technical services. Representatives of HSE and HMIS have had useful talks with the main Committee and will be associated with discussions in the Working Groups.

Press Notice Issued By

Department of Employment of Great Britain

"Vinyl chloride code of practice. New evidence on the health hazards associated with vinyl chloride and a reduction in exposure levels were discussed at a meeting on Friday, June 14 between the Factory Inspectorate and representatives of the TUC (Trade Union Council) CBI and Chemical Industries Association. Mr. Brian Harvey, Chief Inspector of Factories, who chaired the meeting stressed that although only one case of angiosarcoma of the liver, probably associated with vinyl chloride had been traced in Great Britain, it was necessary to take a cautious attitude. It was agreed that the published standard of 200 ppm should no longer be accepted and that an interim hygiene standard should be substituted of a ceiling of 50 ppm and a time weighted average of 25 ppm allowing that wherever practicable exposure should be brought as near as possible to zero concentrations. The meeting further agreed that the interim standard would be reviewed as further information became available. Action was also agreed on the early preparation of a code of practice giving detailed backing to the policy of limiting exposure to vinyl chloride. To this end two working parties were set

up, one to deal with medical aspects and the other with occupational hygiene. The main working group is to meet at the beginning of August to receive progress reports. Additionally, epidemiological studies of vinyl chloride workers are being mounted and a prospective mortality study of workers involved in the manufacture and polymerization of vinyl chloride monomer separated according to the level of exposure is being set up. A retrospective mortality study of all cases of angiosarcoma is already underway. A census of processing workers is being considered as a basis of a prospective mortality study of this group from which it is hoped to provide confirmation of safe exposure levels."

bi g 3

chloride.

1317

Firestone has two PVC plants.

Our Pottstown plant began producing PVC resin in 1947.

Our Perryville, Maryland plant began producing PVC resin in 1968.

We employ approximately 600 people in our PVC manufacturing facilities, and produce in excess of 400 million pounds per year of PVC resins, thereby making Firestone one of the largest PVC producers in the United States.

In addition, we have three fabricating plants located in Pottstown, Pennsylvania; Salisbury, Maryland; and West Caldwell, New Jersey, that employ approximately 250 people. We calendar and fabricate 75 million to 100 million yards per year of PVC film and sheeting. Therefore, we are both a PVC producer and a PVC fabricator.

Firestone's management is gravely concerned about the potential health hazard which may result from indiscriminate exposure to vinyl chloride monomer. Present medical and scientific data, however, do not justify the abrupt termination of an industry affecting literally millions of people which clearly will occur if the proposed permanent standard withrespect to vinyl chloride is adopted.

Firestone's position with respect to this matter was reached with profound study and concern about the health aspects which may result from undue exposure to vinyl chloride

monomer. As a result of the Company's intensive review and study of the medical problems that potentially exist and the severe impact that adoption of the proposed standard will have on Firestone and the industry, we have concluded that prudent and careful management of all operations involving vinyl chloride are required, and that every technologically feasible method that can be employed to protect the people involved in the industry must be adopted.

Firestone is committed to expend all the capital necessary for the research, development and implementation of those procedures which will reduce employee exposure to vinyl chloride monomer to the lowest technologically feasible level.

Because the exposure levels of the proposed standard are however technologically unachievable, a reasonable and medically prudent exposure level must be selected with the intent of protecting the health and safety of all engaged in the industry. A reasonably achievable and feasible exposure level, in conjunction with safe and practical work practices rules must be adopted with, of course, the overriding consideration being attainment of the most limited exposures of VCM to industry employees.

Firestone submits that a safe and medically sound -- as well as a technolo ically and economically feasible -- standard is that which provides for a 25 parts per million TWA

-- time weighted average -- and 40 parts per million ceiling/exposure level.

Close and careful adherence to this level with appropriate and adequate work rules will assure safe working conditions without destroying the entire industry. These levels, if properly implemented and enforced, will minimize occupational risks and afford the industry and the engineering community opportunities to develop more sophisticated and advanced techniques which can be employed further to reduce the vinyl chloride levels in the ambient air.

The exposure level standard which Firestone proposes, 25 parts per million TWA coupled with a 40 parts per million ceiling -- is not one which is immediately achievable nor a level which can be accomplished without the expenditure of millions of dollars at Firestone alone.

However, it is technologically achievable and although one which will have measurable economic consequences on the PVC industry, which has not been mentioned in any depth in this hearing, it is a level under which the industry can survive. This exposure level should be maintained as the permanent standard until further ongoing medical experimentation and study -- of the human as well as the animal experience -- is completed and more definitive conclusions have been reached concerning the nature and consequences vinyl chloride may have on industry employees.

32

This provision would be one that would exempt areas from regulation where a resin used or handled contains a residual VCM concentration below 0.1 percent. Our concern should be with VCM at the employee breathing level where it may be inhaled and not with the concentration levels that may occur inside a closed container where there is no employee exposure.

The approach of exempting particular areas from regulation where the concentration of the regulated substance is below a certain level has been previously adopted by the Secretary in other carcinogen standards.(20 CFR 1910.93 (c)-(p), 39 Fed. Reg. 3756 (1974))

The Secretary excluded from regulation any solid or liquid mixture containing less than one percent by weight or volume of eight of the carcinogens and for the remaining six excluded any solid or liquid mixtures containing less than 0.1 percent. In so doing, the Secretary stated:

> "The overall purpose of the exclusions is to avoid substantial obstruction, if not stoppage, of the use of many processes and products which are considered useful in industry."

An exposure exemption based on these reasons for the 14 carcinogens previously covered is equally, if not more, applicable to VCM, which is considered a less potent carcinogen than those previously identified.

The standard covers the use of respirators. Because

brg 33

the entire PVC plant complex is periodically or continually exposed to detectable levels of VCM, the proposed standard, in effect, requires that respiratory protection be provided for and used by every employee in the entire complex.

The four types of respirators specified in the proposed standard all require the utilization of a full face piece providing for a positive pressure or operating in a pressure demand mode. Such masks are extremely uncomfortable and burdensome and as stated by Mr. Hyatt: "At best an instrument of torture." He clearly spelled how such devices can induce fatigue, impair efficiency and, in many cases, create other occupational hazards in attempting to resolve one hazard. Actually, the wearing of such masks would constitute a safety hazard in and of itself. Operators and maintenance personnel wearing full face masks and carrying an air bottle or trailing air hose cannot provide the alert surveillance needed to avoid accidents. Faulty maintenance is almost certain to occur because the craftsman cannot see clearly or is so preoccupied with the mask as to lose concentration on the job.

Operators must be able to read clearly the instruments describing the state of the reaction in the reacting vessels. They must be alert for upset or dangerous conditions shown.

They must concentrate on the job at hand. Placing employees in a full face piece, air-supplied respirator will

34 diminish their alertness and concentration resulting in poor work and frequent mistakes.

In the course of performing the requirements of various jobs in the plant, employees must move rather extensively around the equipment, between floors, up and down stairs and distances of 30 to 50 feet and more from a central station. Such requirements for mobility make permanent air stations and hoses totally impractical for most jobs. An allowable alternative is a portable back pack air supply unit.

One model weighs approximately 28 pounds and provides an air supply of about 30 minutes. Assuming an adequate safety factor of 10 minutes, an employee would have to change three times per hour or perhaps use units with larger air supplies weighing up to 50 or 60 pounds.

Moreover, changing of tanks would also impede mobility because in changing tanks the employee would have to be in an area containing undetectable levels of VCM. This would require an employee to leave his work area unattended, a safety hazard in itself, in order to effect a tank change.

Tank change areas would have to be specially built and be securely isolated from the work area in order to guarantee noncontamination. Due to these various factors and inconveniences, Firestone's operating personnel have estimated that probably 25 percent of the present employee staff may either terminate employment or request transfers to different

areas if required to wear such respirators during a major portion of their working day..

Firestone submits that the use of air supplied respirators are only necessary when concentrations of VCM reach excessively high levels and that when such incidents do occur, full-face masks are not necessary and are in fact dangerous to employee safety for the reasons given. Respirators which are less cumbersome and provide the employee a greater degree of visibility, mobility and comfort, such as canister type respirators, should be substituted.

The proposed permanent standard requires that employees entering a regulated area shall wear protective full-body clothing, footwear and gloves. Protectiveclothing is defined to be clothing protective against VCM. To be "protective against VCM", such clothing would have to be impervious to air due to the fact that VCM is a gas.

As a consequence, such clothing would also be impervious to body moisture, resistant to heat passage, and would tend to be extremely abrasive to the skin. In effect, therefore, although the proposed permanent standard attempts to make a distinction between "protective" and "impervious" clothing, the distinction made is without a difference because impervious clothing will be required for all employees on all occasions.

Employees required to wear such clothing will be

subjected to almost intolerable work conditions because the clothing will produce much heat and discomfort. These conditions will also produce fatigue, reducing employee alertness. In addition, since such a suit would be impervious to VCM, a garment of this type would tend to guarantee long-term exposure to VCM if, by chance, some of the gas entered the garment.

Use of gloves will diminish an employee's dexterity and would be objectionable for most jobs because operators will find it difficult to operate controls and keep records, and maintenance men, particularly instrument and electrical repairmen will not be able to perform their work safely and properly.

Thus, because of the reduction in employee efficiency due to the cumulative effects of fatigue, the dangers of unsure footing and decreased hand and finger movement, maintenance, repair and other such work will take substantially longer than what is now experienced. Increases in maintenance and repair time could foreseeably require certain production segments to shut down completely disrupting the entire production process.

Although the standard writers may have intended to protect employees from exposure to VCM by requiring them to wear protective clothing, ironically such clothing really does not afford an employee any more protection than if it were not worn. As a gas, air-borne VCM will not cling to clothing, skin

bng 43

potential of being abused by troublesome employees.

For example, an employee looking for a long break, an employee desiring to harass a supervisor or an employee just looking for a change of pace could easily simulate an exposure to VCM while not being monitored in order to be sent to the hospital or physician's office to begin his medical surveillance. If monitoring were too strict for a pretended exposure, a brief real exposure could easily be arranged.

Another major drawback to this requirement is that even a minor incident might require that half or all of the working crew report to a physician's office within 24 hours of the emergency. The safety of the plant might go completely begging while unqualified operators covered the jobs vacated by regular operators who were out of the plant beginning their medical surveillance.

Finally, any standard which requires employees to abandon an area where there may be an unexpected exposure to VCM and only permitting return to the area after employees have donned air respirators, would be unwise. Evacuating the area when an alarm sounds, and not remaining to see what has happened is a situation which must be avoided if any emergency is to be quickly, efficiently, and safely brought under control.

In emergencies it may often be more prudent to accept a brief exposure to VCM to avoid a larger exposure or a mushrooming hazard. It would be impossible to guess how many

lives have been saved by prompt action in sealing off ruptured lines, closing valves and transferring batches from leaking reactors, action which would be prohibited if the proposed standard is adopted.

Firestone has ordered and will install multipoint, constant, sequential monitoring systems which will plot on graph paper the level of VCM exposure. These graphs will show amounts of VCM released at all times and during any emergency.

Such a fixed system continuously checks many areas, and via its early warning capability greatly minimizes exposures. It continuously cycles monitoring samples to an infrared or chromatographic analyzer thereby producing instantaneous results indicating exposure levels in excess of that permissible. The only monitoring equipment currently available for the individual is the air bag or carbon tube sampler which require extensive testing through analytical procedures to determine the results. By the time such results have been analyzed they are after the fact in that the employee may already have been exposed to a level in excess of that permissible.

A fixed monitoring system permits the immediate feedback of monitoring results and where necessary could alarm personnel to high VCM concentration, pinpoint the area quickly, and permit employees to immediately don air masks.

Are we ready?

MR. KUCHENBECKER: We're ready to go.

JUDGE MYATT: All right.

MR. WALKER: I could just mention, Dr. Baden is now with us, as I referred to him in my talk. He's the deputy chief medical examiner, City of New York, who did some of the medical testimony for us so he's available also.

JUDGE MYATT: Fine.

Proceed, gentlemen.

MR. KUCHENBECKER: Thank you.

Mr. Walker, I would like to commend you for your thorough job of supplying us with data.

MR. WALKER: Is that the end of the question, then?

MR. KUCHENBECKER: That was no question.

I'd like to direct your attention to page 3 of your written testimony, the third full paragraph contains the statement that, "Firestone submits that a safe and medically sound standard is that which provides for a 25 ppm TWA and 40 ppm ceiling exposure level."

I wonder if you have any medical data to support this conclusion?

MR. WALKER: Well, let me say, go back into the total background of the how and why we developed the figure We did-which we're supporting.

First, as I stated, and is recorded with the submission,

we undertook an indepth technical feasibility study at four different levels, 50, 40, 15 and no-detectable.

We did this not unilaterally, but in conjunction with Catalytic, Inc., who is a well known engineering firm and with Dr. Higgins whose credentials are attached also. The fact that 50 and 40 are people where willing to commit could be obtained, even though up to $20 million was involved, at 15 parts per million, we would not get anybody including our own engineers to say, per facto, you could do it, but they would say you could not do non-detectable.

Now, taking our own medical study, which is submitted today, we've been in business 27 years.

We've produced in excess of two billion pounds.

We're no different than any other producer which we've been hearing here.

I am sure the levels of VCM at our plant as well as at others was in the thousands years ago.

It was, until, I think, '67, it came to 500. It's down to 50. We are volunteering or recommending tightening the 50 in half.

The DOW data which I think is excellent shows 15 years of monitoring, -- shows that under 200 parts per million they have absolutely no abnormalities and I think the study submitted by people like Air products both on their death certificates and on medical surveillances is very encouraging.

Now, if 200 appears to be safe, 25 we say is medically prudent. I don't know if that answers your question or not.

MR. KUCHENBECKER: Do you consider that medically prudent or medically safe?

MR. WALKER: We'll go along with both words.

MR. KUCHENBECKER: All right.

Let me direct your attention to page 4, the bottom paragraph.

We've had the opportunity during the hearings to listen to the presentation of SPI at great length.

You stated here that you do not totally concur with their position.

I wonder if you could elucidate on this point a bit for us.

MR. WALKER: Well, primarily, we don't concur with the stepdown committed to prefacto. In other words, I think the first year of our recommendation, the first year of SPI, is, in fact, common 25, 40. We're committing our best effort to minimizing.

We are not picking up numbers and hoping we can get there. We're committing effort, not conjecture.

We're not committing -- you see, in our written testimony to reducing the residual monomer level down to 100th of a percent. We're going to try to get it low but I don't know where -- how we could support a number like that. We do

concur with the overall commitment.

In fact, I think if SPI, as you heard many of the companies who are in SPI, like Goodrich, Air Products, those numbers, are-exposure levels, They are a traget, best effort.

But, they're concerned as we are. We have no way of picking a number out of a prefacto and therefore it sounds better to say 25 or 25 and 10 is strictly conjectural.

That's really the only major difference between SPI and Firestone.

MR. KUCHENBECKER: May I direct your attention to page 5 of your written testimony.

You mention here a Mr. Barnes, Chairman of the Chemical Industries Association.

MR. WALKER: That is correct.

MR. KUCHENBECKER: Great Britain?

MR. WALKER: Yes.

MR. KUCHENBECKER: Do you know whether he's a representative of the vinyl chloride manufacturers in that country or-a-representative of the government?

What capacity?

MR. WALKER: I think he's a member of ICI, the British company, and also, responsible for the Chemical Industry Association.

He's chairman of the vinyl chloride group, but an employee of ICI.

MR. KUCHENBECKER: The second paragraph on that page you synthesize his press conference presentation stating, "The crux of the United Kingdom situation is that they have been able to reduce their mid-1973 VCM exposure levels at 150 ppm, TWA to current VCM exposure levels of 50 ppm, TWA."

Are you aware of any steps that perhaps state as to how they were able to do that?

MR. WALKER: No, no.

I think this was NA -- it was CME report, and I think the British Embassy also sent us this information.

MR. KUCHENBECKER: So, I take it that they merely --

MR. WALKER: I'm sorry.

MR. KUCHENBECKER: So, I take it, they merely stated conclusion with nothing to support their accomplishments?

MR. WALKER: Well, I think what they did, was report that their readings over the years, their exposure came from the thousands down to 150 in '73, they're down to 50 TWA.

All they're saying, they are going to put a million pounds to the lowest level possible, but there's no way 10 TWA is their goal.

They are not sure if they will make it until they put the equipment in. The reason we bring this up is that it's important.

We only make 25 percent of the world's PVC.

If we're going to be operating nondetectable, they're

operating at 50. I believe ICI had one of the 16-19 angiosarcoma deaths and died in an automobile accident with it, not of it.

They're concerned but they know their people over the years were exposed to mass quantities and they feel 50 time-weighted average is reasonable and they're going further but they're not going to pick a number out like 13.3 and commit to it.

MR. KUCHENBECKER: All right.

Let me direct your attention to page 6, the third full paragraph, first sentence.

You state you have committed millions of dollars to minimizing the vinyl chloride monomer exposure level.

MR. WALKER: I'm sorry.

I can't hear you.

Would you speak up, please?

MR. KUCHENBECKER: You have stated Firestone also committed millions of dollars to minimizing --

MR. WALKER: Yes.

MR. KUCHENBECKER: -- vinyl chloride monomer exposure in your existing operation.

Could you be specific as to the equipment that this money has been allocated for?

MR. WALKER: It's all attached or a great portion of it attached in case 4, which is the 25 TWA, 40 ceiling itemized

by individual pieces of equipment by area, by estimate, delivery time, by catalytic, not by just Firestone, and involves about half of the items. It does not involve in our initial effort the decontamination, exhaust gases but there are things like compressors, chem pumps, and they're all itemized page after page.

50 part ceiling, the other

Also, page 3, / is : 40 and 25, you see the equipment involved as you step down.

MR. KUCHENBECKER: All right.

On page 7 /the large paragraph in the middle of the page, you have stated, "It is entirely proper to inquire into the possibility that man is considerably less susceptible to angiosarcoma than rodents."

Do you have any scientific data that you might give us that shows, man is less sensitive in these test samples?

MR. WALKER: Excuse me -- I think the answer we gave on that, there have been millions of man hours of exposure of human beings over forty years of PVC, not at 50 but at 500, 2,000.

Now, if man were as susceptible as rats, mice, guppies, whatever they are, then in fact we would have a substantially greater number of deaths.

We've been in the business 27 years --

MR. KUCHENBECKER: So, this statement is based on your own experience, primarily?

MR. WALKER: Human experience.

I am sure Mr. Kuschner made the statement which is attached again in the record from his own basis but when he was doing, was studying the information we had provided him like the Maltoni, the Bio-Test, the Kuschner-Rose study and the human experience, information which is available.

MR. KUCHENBECKER: On page 8 of your testimony you mention the fact that five deaths resulted from angiosarcoma, occurred at the B. F. Goodrich plant.

This has been frequently referred to throughout the hearings.

From your experience in the industry, could you offer any explanation as to why so many deaths resulted at one particular plant?

MR. WALKER: Well, no.

I think Goodrich Company can best answer that, an ordinary plant.

You take the angio deaths. You've got seven at Goodrich, three at Goodyear, two at Carbide, one at Firestone.

The other 45 plants or whatever it is in total don't have any which is a little bit strange but I don't know how to answer what problems Goodrich might have at Louisville or Frederick town Diamond might have at Deer Park, Texas.

MR. KUCHENBECKER: Do you have any significance to attach to that fact?

MR. WALKER: Yes.

I don't quite understand what you're asking me.

MR. KUCHENBECKER: You mentioned it and attached something -- some significance to it.

I wonder what the purpose was?

MR. WALKER: Well, if I were reviewing from an outside view, we don't have access to these other plants like OSHA or NIOSH.

I certainly studied it very closely. When you have 40-some odd plants producing either VCM or PVC, and you have a cluster of deaths in three or four of them, I say that there's something very statistically significant.

I don't know what it is.

If they were to invite me in I'd be glad to look.

MR. KUCHENBECKER: On page 11 of your testimony you mention the preliminary findings of Dr. Pasternak and those findings of Dr. Baden.

Do you have any idea when the full findings will be available?

MR. WALKER: I referred to them as initial but they are really final findings at this moment.

MR. KUCHENBECKER: They are attached?

MR. WALKER: They are in the record, correct, page 1720 in the appendix. I did mention there are two cases of 87 deaths in the last 27 years. We were able to find 85 of

the 87, two not included because we didn't have the death certificates.

MR. KUCHENBECKER: Perhaps this is part of my next question.

On page 12 you talk about physical examinations and that exhaustive set of liver function tests were performed on your employees at the Pottstown-Perryville plant.

Have you conducted any studies on the employees not currently employed at the facilities?

MR. WALKER: No, we have not at this point.

MR. KUCHENBECKER: All right.

Could I direct your attention to page 18 of your testimony.

You're talking here about the studies that were carried out and the conclusions that were a result of this.

Could you tell me if there were any underlying assumptions upon which you rested your studies to give us a better idea of what issues were considered.

MR. WALKER: Well, we established, as I mentioned, 4 different targets, 50 ceiling, 40 ceiling, 25 TWA, 15 ceiling, and 10 TWA, and non-detectable, that was the target.

Our own engineering department staff, Catalytic and Dr. Higgins, and the message was can you get there and what is required and the answer was they would commit the 40 but they wouldn't commit past that, prefacto. They would say that no

determinable, you can't get there from here.

MR. KUCHENBECKER: For example, did they consider the possible development of more sophisticated equipment in this study?

MR. WALKER: Well, there is no engineering consultant or your own going to make a commitment based on hopefully somebody designs something before the order comes in.

We are saying with the best equipment possible that exists, real equipment, we can't do it. It's a gas.

MR. KUCHENBECKER: All right.

On page 19, the second sentence on the page --

MR. WALKER: What page was that again?

MR. KUCHENBECKER: Page 19.

MR. WALKER: Thank you.

MR. KUCHENBECKER: You mentioned the statement by Dr. Higgins here.

MR. WALKER: Yes.

MR. KUCHENBECKER: Regarding the anticipated problems that could be overcome only through the use of especially designed equipment and newly created engineering processes.

MR. WALKER: Yes.

MR. KUCHENBECKER: What were these problems?

MR. WALKER: Well, I don't know if -- even if he knew, he knew, he'd better have a pump that doesn't leak and a

low leaking valves leak.

valve that doesn't leak, and/Maybe not as high as a leaking valve, but they can leak.

What he is saying is, especially designed equipment and newly created engineering processes.

I don't think he actually knows what they are, but he knows what exists, not going to make it come out right.

MR. KUCHENBECKER: Did this study consider any of the specially designed equipment that he thought could deal with this anticipated problem?

MR. WALKER: No, it did not.

I think what his study -- again, this is also attached, that the non-detectable level, everything, there is equipment that existed, rotary compressor, chem pumps, there is no Alice in Wonderland at all.

MR. KUCHENBECKER: Let me direct your attention to page 22.

MR. WALKER: Just a moment, please.

If you're starting at page 196, there's Dr. Higgins' submission on the Pottstown study, which again -- it goes into every building we have by level, by what we can do.

I might direct your attention if you would to page 211 in the text and maybe that will answer some of your questions, and th appendix -- excuse me.

I think that's the type of information. Do you have it in front of you?

MR. KUCHENBECKER: I haven't been able to look at it before.

Let's move on.

MR. WALKER: Fine.

MR. KUCHENBECKER: Let me direct your attention to page 22.

MR. WALKER: 22?

MR. KUCHENBECKER: Yes, the second paragraph, you state that Firestone -- you believe the rest of the industry perhaps has been able to reduce vinyl chloride concentration ceiling levels in many areas of the operation to less than 55 parts per million.

MR. WALKER: Yes.

MR. KUCHENBECKER: How long did that take?

MR. WALKER: How long did it take?

MR. KUCHENBECKER: Yes.

MR. WALKER: I would say we did like other companies, we've just been routinely coming down but we were operating at a 500 ceiling.

I don't think we were anywhere near a 500 for the last year or two but when the temporary emergency standard came out we did have to take some very quick engineering changes.

Now, I heard it said before here, when you have a problem you start looking, you do notice a lot of things.

For example, we upgraded our ventilation, aerated and

a number of changes.

We made sure all of our reactors had drop line ventilation as we call it, so we pull it out through a compressor, not blow it out into the reactor room.

Any emission that was inside the plant, we immediately piped it to the external or outside the plant. We instituted some work practice procedures in unloading areas, how you purge out or blow out lines the underlying.

We raised exhaust stacks on every roof to get them higher and higher so we're not blowing it out the roof and bringing it in the window.

Now, this collection is what I say is the reasonable capital outlays. It's things that were done in 90 to 120 days and enabled us to get our Pottstown plant, for example, down to the 30 ceiling with the exception of eight places which are clearly posted, demanding air respirators. Those aren't going to be short-term solutions. Those are going to be long-term.

MR. KUCHENBECKER: As far as your other plant, how low were you able to get down on that location?

MR. WALKER: We have in Perryville two or three spots that are posted which are commonly over 50 versus eight places in the Pottstown plant.

Perryville is six years old, much more modern, much more spacious.

Pottstown is 27 years old but in both plants we have

a number of posted areas demanding air respirators to be in it.

MR. KUCHENBECKER: I take it from the data you have submitted and specified these problem areas that you haven't been able to get down to 50 ppm level?

MR. WALKER: They're clearly outlined.

MR. KUCHENBECKER: Perhaps I didn't catch this in your testimony.

Did you state that monitoring had been conducted at all your plants, both the PVC and the fabricating plants?

MR. WALKER? Absolutely.

Now we're using air bags now because we don't have delivered yet the constant sequential monitoring equipment but we have several thousand readings.

MR. KUCHENBECKER: When you say air bags, does that personnel monitoring?

MR. WALKER: Personnel, but we prefer. We think air is more absolute than the use of charcoal tubes. We use air and gas chromatograph. Ten minute samples, occasionally four and eight hours, TWA samples to get a good breakdown by job classifications as well as area.

MR. KUCHENBECKER: So, this data does include the various job locations as far as the levels found?

MR. WALKER: We submitted to OSHA during one of their inspections 250 pages of monitored air bag gas chromatograph data for every classification we have on every area.

we have in our chemical plant, is over 2,000 individual readings of the people where they were taken, when they were taken, what areas, etc.

MR. KUCHENBECKER: Good. I just -- I wanted to make sure.

On page 25 of your testimony you talk about the additional studies that were developed to estimate the weighted time rated feasibility and capital cost of achieving the 25 ppm/average, of 40 ppm and ~~the~~ 40 ppm ceiling.

Again, I take it that these studies are part of the document submitted.

MR. WALKER: They are.

The first study was 50 because that was the temporary standard, but when we started studying that we got a new goal very quickly, which is why we did the additional ~~We obviously want to~~ 40, ~~and~~ 15, and non-detectable.

MR. KUCHENBECKER: Okay.

On page 26, the fourth paragraph, you state that you estimate as much as $10 million will be required to insure your operations are not exceeding 50 ppm in any area.

MR. WALKER: Right.

MR. KUCHENBECKER: Did you, in order to arrive at this figure, did you use any date line, for example, did you use the October 5th time?

MR. WALKER: We'll never be down to 40

1973

ceiling, let us say, ~~by~~ October 5th. We'll still need the air respirators because some of the equipment we're putting in again, starting on page -- I don't know, what is it -- 39 --

MR. CONNOLLY: Would you give me my book back?

MR. KUCHENBECKER: You want it right now?

MR. CONNOLLY: Yes.

MR. WALKER: If you can turn to page 42 in the appendix, you'll see -- I'm sorry, that's non-detectable, page 59 is the ~~a~~ 50 ppm ceiling study, you'll see the tank form area, changes in work practices, engineering controls, you'll see the exact definition of the piece of equipment such as a portable unit for airing out ~~the~~ storage vessels. The capital cost, now as given at $25,000 and the time to install is thirty weeks so that for every piece of equipment whether it's in the polymerization building area, in the bulk area, spray dryer areas, warehouse, every area is broken out, every piece of equipment, dollars and estimated time and it'll take us we say for a permanent basis as much as two to three years.

In other words, we will have to continue to use the air respirator in certain areas while this equipment is being installed as we are now under the temporary.

MR. HOY: That only covers one plant. The other plant is on marked page.
MR. WALKER: This I referred to is the Pottstown chemical plant.

There is another study in here for the Perrysville plant.

MR. KUCHENBECKER: All right. Fine. I would like to direct some

questions to Mr. Hoy, if I ~~may~~ might.

I have a few brief questions for you.

On page 2 of your testimony, the second sentence on the top of the page, you have stated the risk of exposure in areas where PVC is repackaged, stored or used is very small, if not virtually non-existent.

Could you explain why this is the case?

Is it due to automation or --

MR. HOY: I think it, as has been ~~pointed~~ brought out in the -- emphasized -- let us say, in the various testimony you have heard here ~~with~~ were those people who are handling resins are picking up levels of from 1 to ~~ten~~ extremes of 14 parts per million, and this is what we're talking about here -- areas where you handle the resin.

MR. KUCHENBECKER: All right.

Let's talk a moment about your fabricating plants at ~~that~~ Firestone --

MR. WALKER: That would be more my responsibility, if you don't mind.

MR. KUCHENBECKER: Okay.

On page 3 of Mr. Hoy's testimony, the third paragraph mentions where a resin used or handled contains a residual VCM concentration below a tenth of a percent.

MR. WALKER: Yes.

MR. KUCHENBECKER: Is this the average amount of vinyl chloride monomer residue that's present in the PCV?

MR. WALKER: No.

It varies greatly. It varies, for example, plastisol or dispersion grade resins, ~~it has~~ very fine particles, ~~that are~~ spray dried, Normally, ~~it~~ has less than 25 or 10 ~~particles~~ per million because it is a special type of resin but most of the suspension resins range from several hundred parts per million up to a thousand which is not uncommon, which is one-tenth and a number of co-polymers are in the 2,000 area.

MR. KUCHENBECKER: Do you supply yourself with your own resin?

MR. WALKER: Yes.

MR. KUCHENBECKER: Are you the sole supplier for your company plants?

MR. WALKER: Yes, we are.

MR. KUCHENBECKER: You are. Why have you chosen this tenth of a percent level as a provision that you would suggest?

MR. WALKER: We've submitted to SPI, and as a matter of fact, to the Department of Labor, a very in-depth gas chromographic ~~of~~ evaluation of our calendaring plant which pumps out 75 to 100 million yards a year of vinyl, ~~and~~ running vinyl through that plant, ~~let's~~ say at a tenth of a percent or less, which is a thousand parts per million residue.

There are no numbers in the breathing zone of an employee that are more than two or three parts in the breathing zone. Now, if you want to crawl into a bulk tank you can

go into the air space and it'll be there, but people don't go there.

This data was submitted to ~~us~~ SPI and also to OSHA.

MR. KUCHENBECKER: These levels that are found at various points in the fabricating plants, were they arrived at before any new engineering methods were installed?

MR. WALKER: Yes. We haven't taken any massive action in our fabricating plants, although frankly we are going to be increasing the ventilation system in the calendar plants, especially in the areas where you are going to be milling, band bearing, mixing, we do have plans to substantially upgrade the amount of the air, the air changes.

MR. KUCHENBECKER: Is that the primary means by which you hope to reduce the levels of vinyl chloride monomer?

MR. WALKER: Yes. The only area that again we bring the resin in in bulk, the air is conveyed into a blender which is closed.

The blender is ventilated to the outside goes into a banned area, which is also ventilated from the outside.

Again, as I said, I don't think we have a reading of over three or four parts per million in the entire plant of any breathing zones. So increasing ventilation, I am sure, will bring it down further, but I don't know how far.

MR. KUCHENBECKER: Do you do the same type of monitoring, maintenance of medical records, things of this nature, in your fabricating plants as you conduct in your PVC plants?

MR. WALKER: Essentially the monitoring at this moment is similar, which is, I think the standard tells us if you

check it three weeks in a row if it is under 50. You check it monthly. We are not using the centry meter, for example, It is not sensitive enough to pick it up, so we have to use the air bag, which is the same thing that we are using at the chemical plant.

We are not planning to putting any constant monitoring in the calendar plant.

MR. KUCHENBECKER: Perhaps, I would like to go back to Mr. Hoy's part of his testimony.

On Page 6, the percents in the top paragraph there.

You state that Firestone submits that the use of air supplied respirators are only necessary when concentrations of VCM's reach excessively high levels.

In your estimation, what would these level be that would necessitate the use of respirators?

MR. HOY: I think the best way to cover that is with the intent of what has been said.

What we are saying is that canister type respirators are good for certain exposures, certain levels, to the extent that they can be shown to be applicable, they should be allowed.

Beyond that, obviously you would have to go to something which is -- to air supply respirators.

MR. WALKER: I would like to add something to that, if I might.

Hyatt, Dr. Key, Mr. Strassburg, Mr. Oelfke, all

conducted, as we heard in this hearing, tests on feasibility canister type respirators. [illegible] people concluded that they could be used safely at concentrations below 50 parts.

Strassburg concluded that canisters would last 11 hours and we say that eight is minimum average. There is no way of telling when they are exhausted.

Strassburg concluded that canisters would last 11 hours at levels up to 100 parts per million, and observed somewhat longer periods without breakthrough.

All the point we are saying is we are hopeful that exposures up to 100 will be able to be handled by a canister which will make it a lot more practical for the employee.

MR. KUCHENBECKER: Have you conducted any studies yourself on this point, or do you live with these studies that have been presented?

MR. HOY: We have not conducted any such studies.

MR. KUCHENBECKER: Let me direct your attention to page ten of your written testimony.

The third sentence in the top first complete paragraph.

MR. HOY: Yes, sir.

MR. KUCHENBECKER: You made it a point to mention that an air supplied mask's trailing hoses constitute a safety hazard to employees engaged in these activities.

Do you have any experience at your plants that

would demonstrate that these hoses do present a safety hazard?

MR. HOY: Are you asking if we have had accidents with hoses?

MR. KUCHENBECKER: Yes.

MR. HOY: I am not aware of accidents in Perryville. Have we had accidents in Pottstown?

MR. WALKER: Our reactors are beyond or below 50 parts before they are entered. Therefore, under the temporary standard the mask isn't required, which means that we don't have --

MR. KUCHENBECKER: So you have had no experience?

MR. WALKER: Pardon me?

MR. KUCHENBECKER: Excuse me, continue.

MR. WALKER: Well, we have no had experience of people tripping over that air hose, because they are not using it yet.

MR. HOY: I missed the point of that.

We are talking about reactors here, and we don't use in reactors air hoses. Air supplied, and respirators.

MR. KUCHENBECKER: Thank you very much.

MR. FLINT: Gentlemen, I am aware that you have furnished -- first, I would like to say that this is the most thorough job that I have ever seen anywhere on anything, and I know you have furnished some monitoring information to us previously, but would it be imposing upon you too much to

furnish your most recent data on exposure of job classifications?

MR. WALKER: Not at all, we would be happy to.

MR. KLEIN: We could appreciate that. And if you can approximate the length of exposure as well. Would that be too much of a burden?

MR. WALKER: I am not quite sure what you mean.

Each employee very clearly says whether it is a ten minute sample, whether it's a four hour TWA, whether its an 8 hours--Is that what you are reading?

MR. KLEIN: I see. You have TWA's available, is that what you are suggesting?

MR. WALKER: No. Most of the samples we are using, we are trying to spot the trouble areas, so we are using ten minute sampling and that is most of what the data is, and a spot checking occasionally with the eight hour air bag. But it is broken up neatly by area.

MR. KLEIN: Now, I get the impression from your testimony that you are reluctant to expend large sums of money unless you are sure you can reach a particular level, is that an unfair inference?

MR. WALKER: No. No. I think what we are saying is that it's almost impossible accurately to forecast sums of money which will be increasingly required to decrease the exposure level.

Examples: Consideration, decontamination, carbon absorption, whatever you want to call it, of those exhaust

Mr. Klein: OK. Fine.
Mr. Walker:

gases. At some point when you are having to get to a very low level, you better consider incineration. You can't blow it out the roof and expect it not to come back in the windows.

Now, when you say how much does it cost, you will see some of the incineration costs are $4 and $5 million and the systems aren't really proven yet, that is engineeringly

MR. KLEIN: I am talking more in terms of reaching a particular level.

MR. WALKER: Well, you see -- no.

We say up to $10 million to get everything below 50. But I said in my oral, it depends on whether we have to go to the incineration.

If we put everything in but incineration, and we are below 50, we are not going to spend $10 million.

MR. KLEIN: Perhaps I'll rephrase the question. Your reluctance to join SPI's recommendation seems to be based upon a feeling that it is speculative as to whether or not that level can actually be reached?

MR. WALKER: That is right.

MR. KLEIN: Or those levels.

MR. WALKER: That is right.

MR. KLEIN: The impression that I had from your testimony, I'd like to clear up, is that you were reluctant to spend large sums of money if you weren't sure that you could attain a particular goal level.

MR. WALKER: We are going to spend the money

regardless of whether OSHA sets a standard at 98 or 8~~5~~, and I don't mean that facetiously.

What we don't know is when we are all done spending it whether we have a 25 ceiling and a ten TWA, or a 15 ceiling and an eight TWA, or it really is a 40 ceiling any way.

We don't know. But we are already committed. We've already got have half a million dollars worth of monitoring equipment on order. That is a 60 point system for the Pottstown plant, ~~it is~~ a 72 point system for the Perryville plant, readings every four to nine minutes on each spot. That money is being spent.

The medical surveillance, we are through. We're just putting the records together. We have millions of dollars right now, approved by our corporate people, to again reduce ~~the~~ it. The only thing that is different in our presentation is we are going to tell you after we put it all in what we have done. Not speculate by saying would you like to hear ten, we will say ten.

MR. KLEIN: I will try to rephrase it one more time.

Are you suggesting that OSHA set only a standard which you are sure you can attain?

MR. WALKER: I think that we are telling, or suggesting to OSHA that it set a standard that is based on fact; that ~~at~~ if 25 and 40 it is considered medically prudent ~~proven~~ with the kind of data that has been presented here, why set it for lower

and lower and lower numbers if there really is no gain to it.

MR. KLEIN: Leave aside the medical question, and I understand your position is different than others who have testified.

But, assume for a moment that it is a dangerous carcinogen, would you have OSHA set a standard which would only set a standard which you were sure ~~that~~ you could meet, or would you have OSHA set a lower standard?

MR. WALKER: Well, I think OSHA sort of established that in the asbestos case, I believe where they didn't take the very best situation, they didn't take the very worst, they took something in between.

Now, if you set a standard of extremely low exposure, what you are saying to some extent is that if your plant happens to be in the southwest, or far west, or it is only five years old, you may survive.

If your plant is 27 years old, 20 years old, spread out all over New England, like many are, you are out of business. ~~This~~ That's is not a very good answer.

Especially when, as far as we are concerned, we are treating VCM as a carcinogen.

MR. KLEIN: Okay.

I will ask you one more time.

I would appreciate a yes or no, and then you can explain all you want to, okay, is that fair enough?

MR. WALKER: Yes.

MR. KLEIN: Would you have OSHA set a standard, only set a standard which you were sure ~~that~~ you could meet?

MR. WALKER: I think OSHA ~~is~~ sets a standard, not based on what people tell you they can meet, but a standard that is responsible itself.

As far as we are concerned, a standard has to be technologically feasible, and there should be information, other than rats and mice, to set a standard of "no-detectable."

I think you have heard in this hearing several doctors state that the safety factor going from 25 to ten is almost negligible. That is ~~when~~ Dr. Schneiderman -- excuse me -- falls ~~off~~ the end of the desk or something --

MR. KLEIN: Let us talk for a brief moment about the economic study.

MR. CONNOLLY: Time -- excuse me.

MR. KLEIN: Excuse me.

(Discussion off the record.)

MR. WALKER: I am sorry.

MR. KLEIN: That is okay.

MR. WALKER: All set.

MR. KLEIN: Let us talk about your Pottstown plant. What is the gross of that plant?

MR. WALKER: What is the what?

MR. KLEIN: The gross income from PVC of the

Pottstown plant.

MR. WALKER: The gross income?

MR. KLEIN: Yes.

MR. WALKER: I am not sure where that is germane. We have 400 million pounds of resin, and our sales are not broken out, even within the corporate -- by company, or never by plant.

MR. KLEIN: Okay, at the two plants, then.

You have 400 million pounds, you said?

MR. WALKER: Collectively between Pottstown and Perryville.

MR. KLEIN: Okay. How much. Approximately how much per pound do you charge?

MR. WALKER: It varies from 22 cents, I believe, for general purpose resin, up to close to 60 cents for specialties.

MR. KLEIN: Is there a rough average?

MR. WALKER: Probably somewhere in the 30 cent area, maybe.

MR. KLEIN: Okay. Now, the economic -- let me digress for a moment -- in the conomic studies that you have done, do you have an estimate when you are shooting for 0.1 part per million, do you have an estimate as to how low you could get instituting those --

MR. WALKER: No, I am sorry. Once we get under

the 40/25, we are are saying again, we are committing the capital as being spent.

We think we do as good as, if not better, than many of our competitors.

I don't really know whether it is going to be 21, eight, six, what it is going to be.

MR. KLEIN: It is possible, is it not, that you could attain that level?

MR. WALKER: Which level, 21, eight, six?

MR. KLEIN: One part per million.

MR. WALKER: Not in our opinion. Not in Dr. Higgins' opinion, and not in Catalytics' opinion.

I mean, it just leaks. Even without leaks it leaks.

MR. KLEIN: Did they give you an estimate as to what those particular engineering controls would bring in terms of exposure levels?

MR. WALKER: No, I think when they added up all the capital costs it came out between $50 and $55 million for both plants, and if you put it in, you would find out where you would be between 50 and -- in other words, you don't know until it's post facto.

You can't order an engineer to create, he doesn't know.

MR. KLEIN: Would it be fair to say that the engineering controls which you have indicated, shooting for

a 0/1 part per million level would bring about a lower level than the engineering controls which you were going to institute in reaching a ten part per million level?

MR. WALKER: If you are saying, if we are committed to spending up to $20 million, would it be better if we started spending 50 -- I think that is pretty fair, yes, it would have to probably be lower.

MR. KLEIN: I am not talking about money. I am talking in terms of exposure level.

Would that bring about a lower exposure level, in your opinion?

MR. WALKER: You will see one thing that is perhaps in the report, you will see that our cost to try to get to a 15 ceiling/ten, is almost as bad. Almost as much as I should say, as going to non-detectable.

In other words, the curve just doesn't come straight down. The lower you start going, and it gets asymptotic almost

MR. KLEIN: Let's leave aside costs just for a moment. I am talking about engineering controls, okay?

MR. WALKER: They are essentially the same. All right, I don't follow your question.

MR. KLEIN: There are additional engineering controls which you have indicated in your appendix which --

MR. WALKER: Yes, which would be included to reach

a no-detectable versus a 50, yes.

It is equipment added, engineering changes added, when you start going towards no-detectable, yes.

MR. KLEIN: Okay.

I direct your attention to page 85 of the appendix.

MR. WALKER: Fine.

MR. KLEIN: Now, there are listed there certain engineering controls which, if instituted, I assume you believe would reduce the level of exposure, is that not right?

MR. WALKER: Correct. That is the Perryville plant, you realize that. It is one specific ~~further~~

MR. KLEIN: Now, I direct your attention to page 86, and I assume that the engineering controls which you have listed there would further reduce the level of exposure, is that not right?

MR. WALKER: I am sorry, try that question again, please?

MR. KLEIN: The engineering controls which are listed on page 86, is it not right that they too would further reduce the level of exposure if instituted?

MR. WALKER: Yes, they would.

MR. KLEIN: And would that not also hold true with respect to the other plant, the figures that are listed?

MR. WALKER: Conjecturally, yes, you can carry that ~~out~~ over. Which is to say, if I think what you are getting around

to, is if we instituted every known engineering change into each of those plants, we would have a much better chance of having the lowest possible a level than only doing part of them.

MR. KLEIN: I was asking you that.

MR. WALKER: Again, I will come back to capital, because they are the same, even though nobody wants to seem to talk about it.

The equipment in that list costs money. So whether you are spending 20 or 50, the answer is if you are spending $50 million, you are going to have a lot better odds of being lower than if you spend $20, I agree to that.

MR. KLEIN: Okay. Now have you in your economic study, figured out how much, if you instituted the $55 million changes and engineering controls, number one, I assume that you would amortize that, would you not?

MR. WALKER: It would be over a period of time, correct.

MR. KLEIN: Twenty, 25 years, something like that?

MR. WALKER: No, probably 11.

MR. KLEIN: Eleven years. Okay.

Have you figured out the cost per pound, the increased cost per pound that would result if these engineering controls were instituted?

MR. WALKER: No, not on an absolute basis, we haven't, no.

MR. KLEIN: Do you have an estimate as to what you think it would be?

MR. WALKER: Well, what ~~are~~ do you ~~looking at~~ want me to tell -- that we made 400 million pounds, we spent $55 million, and you would like me to tell you what rate we have to amortize that per pound over 11 years with the cost of money ~~now~~ -- no, I ~~would~~ need an accountant here to figure that out.

I think what you are getting around to, I assume, is that we will charge more for the resin which we will then repay for the investment. That is only true if the market will bear it.

MR. KLEIN: I am sorry, I didn't understand.

MR. WALKER: Well, let us put it this way.

Let us suppose that the newer plants don't have to spend the $50 million. Let us suppose the plants in the southwest and the west don't spend $50 million, and let us suppose we raise our price five cents a pound, and the rest of the world doesn't. We are not going to get it.

MR. KLEIN: Well, let me ask you this --

MR. WALKER: For years.

MR. KLEIN: In reaching 50 parts per million, or 25 parts per million, would you, or will you have to make a larger expenditure than the southwestern plants would?

MR. WALKER: Absolutely. They are open air plants. We do that, or our people will freeze to death. ~~We're~~ closed.

I think the Diamond testimony was excellent, between ~~your~~ their Deer Park plant, and their Delaware City plant --

MR. KLEIN: Mr. Hoy?

MR. HOY: Yes, sir?

MR. KLEIN: On page six of your testimony, you talk about protective clothing.

Do you know whether vinyl chloride is absorbed through the skin?

MR. HOY: Do I know whether vinyl chloride is absorbed through the skin? No, I do not.

MR. KLEIN: Now, later you have indicated --

MR. HOY: I think the -- I think that the --

~~MR. KLEIN: Excuse me.~~

~~MR. HOY: I think that~~ the primary concern has been inhalation.

MR. KLEIN: In the course of your testimony you indicated that as a gas, the monomer does not stick to the skin.

MR. HOY: Yes.

MR. KLEIN: Okay. Do you have any data in that regard?

MR. HOY: We ought to, very truly understand the physical nature of the vinyl chloride monomer. It is a good bit like propane gas. You keep it in a tank, 40 pound pressure under average temperature, and you have a liquid.

If you open a valve, what you take off is primarily

a
~~the~~ gas. If you open a valve far enough you can splash ~~the~~ liquid out, depending on the temperature, the volume of liquid, you may get a short stream of liquid vinyl. It immediately evaporates.

If I had a container of vinyl chloride here to pour onto this desk, you would see exactly what I mean. It doesn't stick to the body. It vaporizes. It's a gas.

MR. KLEIN: On page nine of your testimony you indicate that a major portion of the reactors are cleaned through an improved cleaning systems which, to say the least, substantially reduces the number of times that you have to clean.

The first question I have is how many reactors do you have?

MR. WALKER: I will answer that, if you don't mind.

MR. KLEIN: Please, anyone who knows the answer please answer.

MR. WALKER: We have about 65 reactors in the Pottstown plant, ~~and~~ about 20 in the Perryville plant.

MR. KLEIN: Of those, how many ~~are there~~ have this improved cleaning system?

MR. WALKER: Essentially all the Pottstown plant is totally converted to dropline ventilation and high pressure water cleaning, which reduces the need for human being to enter the reactors, to a month or more, that equipment is being purchased, similar equipment is being purchased for the Perryville plant, but is not installed at ~~the~~ this moment.

though

We do have dropline ventilation/so that the monomer is not blown out into the room.

MR. KLEIN: Do -- I will address this to whoever wants to answer it.

Do you have confidence in charcoal as a filtering agent for vinyl chloride?

MR. WALKER: Do you mean commercially?

MR. KLEIN: In any form.

MR. WALKER: Just a minute, please.

Mr. Klein: Sure.

(Discussion off the record.)

MR. WALKER: I think we are ready.

I think your question is directed towards the use of charcoal, for example, for exhaust gases, or was it?

What do you want to do with the charcoal, is what I am asking? What would you like us to consider?

MR. KLEIN: I would like to filter out vinyl chloride with it.

MR. HOY: Are you talking about respirators for personal use?

Mr Klein: Pardon me
Mr. Hoy: are you talking about respirators for personal use?

MR. KLEIN: Well, if there is a difference in the carbon, various carbons.

MR. WALKER: Are you talking about the Calgon, perhaps?

MR. KLEIN: No, I am not talking about anything in any particular brand.

MR. WALKER: I don't know exactly how to answer the question.

If we ~~could~~ can filter vinyl, whether it is out of a ~~dry air~~ dryer or out of a reactor, ~~the~~ through charcoal, recover the vinyl without it polymerizing in the charcoal and use it as a tool to reduce VCM, wonderful, but I don't think any of that exists commercially at this point.

MR. KLEIN: Does it exist in respirators to serve that function?

MR. WALKER: Well, I can only quote what has been said here by -- primarily Mr. Strassburg, who has presented studies ~~in~~ to this hearing on the canisters up to 100 parts per million for 11 hours, and I think that is on page 535 of the hearing.

MR. HOY: Obviously ~~I would~~ they do not use respirators ~~which~~ that have not been tested and certified.

MR. KLEIN: Let us talk about monitoring, briefly.

In terms of measuring employee exposure to vinyl chloride, is area monitoring or personnel monitoring preferred, in your view?

MR. WALKER: I think -- we think area monitoring is the most important.

If I were a man out there, I would not like to find out at the end of the day that I was exposed to 5,000 parts per million, because I don't know exactly what to do about it

after I come home, and which is why we say the area monitoring.

But I guess we do feel that there should be some spot checking by personnel monitoring to conform the area monitoring. One of the keys of the area monitoring is to have enough sample spots, and a rapid enough reading, as I said, the Pottstown plant has 60 spots reading every four to nine minutes.

All we were saying is that there should be intermittent checks with personnel monitoring to confirm the area monitoring.

MR. KLEIN: I believe Dr. Lassiter has some questions.

Thank you very much.

DR. LASSITER: Just to follow up first on the last question.

You, I believe you said you preferred to have area monitoring backed up by personnel monitoring, is that correct?

MR. WALKER: Yes, I think the capability for an eight hour TWA should be used to cross check the area.

DR. LASSITER: You also mentioned as an example how you would find out if you are exposed to, say, a given concentration 95,000, Would you feel that to really find this out on a personal basis, you would personal sampling rather than area monitoring? To an employee, find out that he is exposed to?

1734

MR. WALKER: No, we are really -- if you take a plant like the Pottstown plant ~~or~~ in Firestone, there is only some critical areas, reactors, ~~strippers pump out. They're right under each other.~~ If you have 60 measuring points there, we know where the trouble areas are, and that is where the monitors will be.

DR. LASSITER: You don't have a large number then of 60 or so?

MR. WALKER: Sixty in Perryville, and 72, 25 percent of those stations are floating stations, so if that we have a trouble area we can put 15 stations right in that area, or move them to another area.

DR. LASSITER: Okay. The questions I have are primarily on your Chapter 6 of the appendix --we starting on page 64, it is entitled An Objective Analysis of the Best Available Scientific and Medical Data, et cetera.

~~MR. CONNOLLY: Excuse me, are you talking about the appendix?~~

~~DR. LASSITER:~~ Excuse me, it is not the appendix. It is in the first part -- Chapter 6.

MR. WALKER: What page?

DR. LASSITER: Sixty-four.

Do I address the questions to Mr. Walker?

MR. WALKER: You start here. Then I'll look for help.

DR. LASSITER: You made a statement a while ago

animal data, such as rats and mice, is this correct?

MR. WALKER: That is correct.

DR. LASSITER: What more should it be set on, then?

MR. WALKER: I think the human experience has to be taken into consideration more than the animal studies. As an example, I think Maltoni made it quite clear that those rats that did die at 50, did die at 150 weeks, with the average life of a rat, 100, and died spontaneously, not of, but with.

Therefore, the 50 level that we are now saying that rats get angiosarcoma, and Dr. Schneiderman was asked if he heard it, I think he said that he was dozing off.

DR. LASSITER: Excuse me?

MR. WALKER: Well, that statement was made by Maltoni, what we really have, ~~what~~ I think, is ~~to have~~ human experience, which is more meaningful. With Dow it is hard to ask for more.

You've got
~~You have~~ 15 years of monitoring, 30 years I believe of medical surveillance, and they are one of the biggest.

ONLY COPY AVAILABLE

DR. LASSITER: Okay.

You would also include in the human cases of angiosarcoma in evaluating the whole data picture, is this correct?

MR. WALKER: I certainly would, but I would take into consideration what the industry has been saying collectively and individually all week, that the odor level -- somewhere in the several thousand parts, and it was very common.

We were wallowing in it over the years, including many people in here.

DR. LASSITER: Realizing that with a carcinogen we are not going to be able to have the human data hopefully that brought this case to light, do you agree that we will have to rely on animal results, results of animal experimentation?

MR. WALKER: I think -- I am not going to answer that quite directly.

I think we have heard a number of medical people state that the difference in safety factors from 25 to 20 to 15 is not appreciable in their medical judgment.

DR. LASSITER: Okay.

I want to talk a little bit about the animal studies since you have gone into them a little bit, and I'll just ask you about what you presented.

You mentioned on page 64 that there are no studies animal involving vinyl chloride to so-called higher species, such as dogs or monkeys.